



PALESTINE JOURNAL OF BOTANY

Jerusalem Series

EDITED BY

THE STAFF OF THE DEPARTMENT OF BOTANY OF THE HEBREW UNIVERSITY
(DIRECTOR: A. EIG)

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Summaries in Hebrew



OTTO WARBURG
1859—1938

PALESTINE
JOURNAL OF BOTANY

Vol. I. No. 1

Jerusalem Series

June, 1938

"Palestine Journal of Botany" appears in two series: the Rehovot Series and the Jerusalem Series.

The Rehovot Series is a continuation of "The Palestine Journal of Botany and Horticultural Science", founded by H.R. Oppenheimer in 1935. It is edited by H.R. Oppenheimer and I. Reichert of the Agricultural Research Station at Rehovot. This series is an organ for pure as well as for applied botany. Two issues will be published annually.

The Jerusalem Series is edited by the staff of the Department of Botany of the Hebrew University at Jerusalem (Director: A. Eig). This series is chiefly intended to serve as an organ for regional botanical researches of the Near East countries. Four issues will be published each year.

A brief summary in Hebrew of each paper appears in the same issue.

We wish to express our gratitude to Mrs. Vera Salomons for her generous contribution in connection with the publication of the Jerusalem Series.

OTTO WARBURG

1859—1938

We dedicate the first volume of our Journal to the memory of the late Professor Otto Warburg, founder of the Institute of Natural History of Palestine at the Hebrew University Jerusalem, who passed away on January 10, 1938.

A complete appreciation of the scientific significance of Warburg will appear in the Rehovot Series of our Journal. We shall restrict ourselves here to a short account of some important data of his life. A complete bibliography of the works and papers of the deceased will appear in a later issue of this volume together with a list of plants discovered and named by him.

Born July 20, 1859 in Hamburg, studied at the Universities of Bonn, Berlin, Hamburg (Gov. Chemical Laboratory), took his doctorate in philosophy at the University of Strasbourg (with De Bary) in 1883, worked in Munich University (chemistry with Bayer) 1883/84, in Tuebingen University (physiology with Pfeffer) 1884/85. 1891 Privatdozent Univ. Berlin, 1894 Lecturer at the Oriental Seminary, 1898 appointed Professor, in 1921 Director Agricultural Research Station of the Zionist Organisation in Palestine, since 1925 Professor of Botany and Director Institute of Natural History of Palestine, Hebrew University, Jerusalem.

Outstanding botanical research JOURNEY 1885—1889 to South and East Asia and their island-kingdoms. — CHIEF SCIENTIFIC INTERESTS: Taxonomy of tropical families of plants (*Myristicaceae*, *Pan-*

danaceae, *Begoniaceae*, *Balsaminaceae*, *Moraceae*-gen. *Ficus* etc.), plant geography (Monsoon region, Papuasia, problems of nomenclature), history of cultivated plants, tropical agriculture and colonisation at German Colonies, applied botany and agriculture in Palestine (introduction of new crops, technical plants, etc.). — CHIEF PUBLICATIONS: "Beitraege zur Kenntniss der papuanischen Flora" (1891), "Bixaceae, Winteranaceae, Sabiaceae, Balsaminaceae, Flacourtiaceae, Begoniaceae, Datisceae" of A. Engler, *Die natuerlichen Pflanzenfamilien* (1894-96), "Monographie der Myristicaceen" (1897), "Die Muskatnuss" (1897), "Pandanaee" of A. Engler, *Das Pflanzenreich* (1900), "Monsunia I." (1900), "Die Kautschukpflanzen und ihre Kultur" (1900), "Die Kulturpflanzen der Weltwirtschaft" (1907), "Die Pflanzenwelt I.—III." (1913-22); Editor of "Der Tropenpflanzer" (1897-1920), "Altneuland" (1904-06).

ZIONIST LEADER AND FOUNDER OF MANY COLONISATION ENTERPRISES IN PALESTINE: Since 1905 member of Zionist Executive, 1911-1920 President of World Zionist Organisation.

HONORS given: Genera of plants named after him: *Warburgia* Engl. (*Winteranaceae*), *Warburgina* Eig (*Rubiaceae*), *Warburgiella* C. Muell. (*Musci*). — Honorary President of the Botanical Society of Palestine. — Enterprises in Palestine named after him: "Warburg Grove" of *Pinus halepensis* at the Hebrew University, Jerusalem; "Warburg Garden for acclimatisation" of tropical and subtropical fruits at Rehovot; "Sdey Warburg" — agricultural settlement of German Jews; contemplated enterprises: "Warburg Museum and Library" at the Hebrew University, Jerusalem; "Warburg Botanical Garden" at Mikve Israel; "Warburg Square" at Tel Aviv.

ON THE PHYTOGEOGRAPHICAL SUB-DIVISION OF PALESTINE

By A. EIG

(With 1 map in the text)

In 1931 I published in "Les éléments et les groupes phytogéographiques auxiliaires dans la flore palestinienne" a phytogeographical map of Palestine. In that map the most interesting fact has been emphasized that Palestine is a meeting point of three phytogeographical regions, Mediterranean, Irano-Turanian and Saharo-Sindian. Geographers (e.g. R. GRADMANN), zoologists (e.g. F. BODENHEIMER), and botanists (e.g. SAMUELSSON, F. CHODAT) have since accepted this subdivision.

Further investigations during the last 7 or 8 years have now enabled me to revise this map and to make important corrections regarding the boundaries of the different phytogeographical territories. The principal basis of the map of 1931 was floristic; that of the present map is principally a phytosociological. During recent years phytosociological studies in Palestine have progressed greatly. The composition and the extent of the principal plant associations of Palestine have been studied, and for several parts of the country it is even possible to give detailed phytosociological maps.¹ The problem of the climaxes of the Mediterranean parts of Palestine, complicated as they are in an ancient agricultural country, on the edge of steppes and deserts, has also been considerably elucidated. Phytosociological study in Syria, Iraq and Southern Turkey enable us to check some moot questions of Palestinian phytosociology. On the other hand, in

¹ In 1936 three of our students published (in Hebrew) a first map of this kind concerning a small area E of Jerusalem.

connection with these phytosociological studies it has become clear that the floristical knowledge of Palestine, the basis of the phytosociological studies, is insufficient. It has been necessary, therefore, to postpone further intensive phytosociological studies and start to revise critical groups of the Palestinian flora which are unfortunately very numerous. In these systematic revisions the ecological basis is largely applied. The clear notions in the phytogeographical subdivision of the country have enabled us to disentangle in many cases the most difficult systematic problems. Our phytosociological studies, which are the basis of the more exact phytogeographical subdivisions of the country, advanced as we acquired more exact knowledge of Palestinian species and of their forms. Our floristical, phytosociological and phytogeographical studies are thus closely bound to one another and support one another to a large extent.

The principal points of advance in the present phytogeographical map over that of 1931 are: the more or less exact delimitation of the Irano-Turanian part of the Judean Desert (the Irano-Turanian enclave of Western Palestine); the clear phytogeographical subdivision of the Negeb; the much more exact phytogeographical subdivision of Transjordan. We summarize briefly the results of our phytosociological studies which have served in outlining the new phytogeographical map as follows:

I. MEDITERRANEAN TERRITORIES.

The plant associations of the Mediterranean territories of Palestine have been studied by us comparatively less than the Irano-Turanian and the Saharo-Sindian. The most interesting fact revealed by our studies of the Mediterranean territories is the small size of the Mediterranean territory of Transjordan.

The Mediterranean territories of Palestine were once dominated by forest associations as is the rule in the Mediterranean region. These climax associations of Palestine are the associations of *Pinus halepensis*—*Hypericum serpyllifolium*, a type of *Ceratonia siliqua*—*Pistacia Lentiscus*, *Quercetum ithaburensis*, *Quercus calliprinos*—*Crataegus Azarolus* and probably also a type of *Quercetum infectoriae*.

The principal climaxes are the first three. To one of them (*Quercetum ithaburensis*) we have devoted a separate paper (EIG, 1933). Papers are in preparation on the vestiges of the forest of *Pinus halepensis*—*Hypericum serpyllifolium* and of *Ceratonia siliqua*—*Pistacia Lentiscus*. A few remarks on these forests are to be mentioned

here: there are only few remnants of forests of *Pinus halepensis*—*Hypericum serpyllifolium* in Western Palestine; the best ones are in the southwestern part of Mount Carmel. In Transjordan some beautiful forests of *Pinus halepensis*—*Hypericum serpyllifolium* are still to be seen. Remnants of *Quercetum ithaburensis* are more numerous in Western Palestine and are encountered also in Transjordan. Remnants of type of *Ceratonia siliqua*—*Pistacia Lentiscus* forests are encountered along the sea-coast and on the eastern slopes of Samaria mountains.

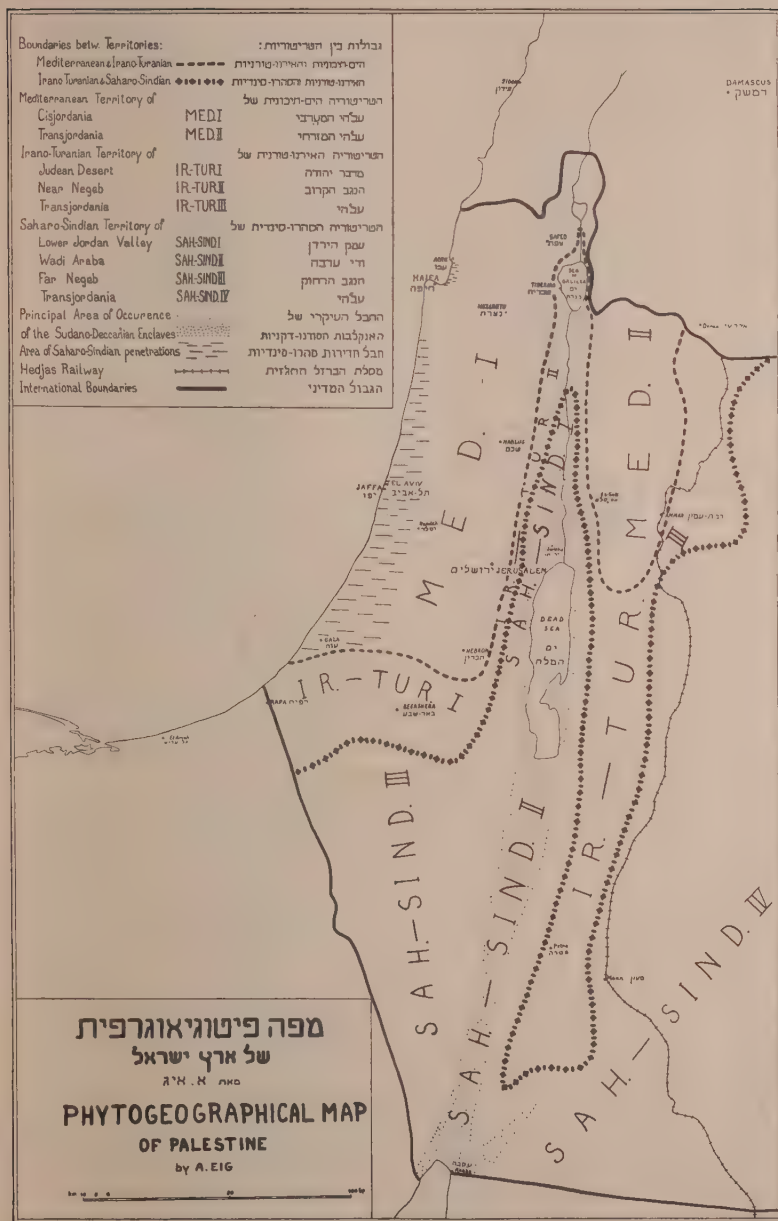
Quercetum infectoriae, a type of *Quercion infectoriae* not yet especially studied, was very scarce in Palestine and its vestiges are encountered chiefly in Upper Galilee. *Quercus calliprinos*—*Crataegus Azarolus* forests we have seen in Syria, on the Lebanon, but also in Jebel Druz, on the Palestinian border. It is very probable that this forest association was once represented also in Palestine, and that some of the Palestinian types of *Quercus calliprinos*—*Pistacia palaestina* Maqui are not degradation stages of *Quercetum ithaburensis* or of *Pinus halepensis*—*Hypericum serpyllifolium* forests but rather of the high forests of *Quercus calliprinos*—*Crataegus Azarolus*.

Maqui, the first degradation stage of climaxes, is still well preserved in many parts of Western Palestine and in some parts of Transjordan. The principal Maqui association is that of *Quercus calliprinos*—*Pistacia palaestina*, represented by several types.

The principal associations of Palestinian Garigue (further degradation stage of the climax associations) are the *Cistus villosus*—*Cistus salviaefolius* association and *Salvietum trilobae* (probably only a variation of the former). In most cases Palestinian Garigue is a clearly transitional formation between Maqui and Batha. Sharply delimited Garigue associations are rather exceptional.

On the contrary, the Batha formation (EIG, 1927), principally the one before the last stage of degradation of climax associations, is widely represented, and its associations are generally well delimited. The principal association is *Poterietum spinosi* in several variations. It is the most widely distributed Mediterranean association of Palestine. *Thymetum capitati* and *Fumanetum thymifoliae* are also rather common on more rocky ground. The most interesting rock associations are *Varthemietum iphionoides* and *Stachydetum palaestinae* (the latter may be only a subassociation of the former).

Of the associations of the light soil belt of the Coastal Plain I wish to mention especially that of *Eragrostis bipinnata*—*Centaurea*



procurens and *Helianthemum elliptici*. This last, notwithstanding the purely Mediterranean climatic conditions, is floristically hardly, if at all a Mediterranean association. To this and to other associations of this belt I shall devote a special article in one of the next numbers of this Journal.

II. IRANO-TURANIAN TERRITORIES.

The Irano-Turanian territories of Palestine are three in number :

(1) The Irano-Turanian enclave of the Judean Desert. This stretches in a rather narrow strip from the Sea of Kinnereth (Sea of Galilee) up to the Negeb along the eastern slopes of the Samarian and Judean Mountains. The most important associations are those of *Retamo-Phlomis brachyodontis* and *Noeion mucronatae* alliances. Several subassociations of *Artemisietum Herbae albae* (*Deserti-Judaicum*) are encountered but are rather limited in extent. Compressed between the Mediterranean territory of Western Palestine and the Saharo-Sindian territory of the Lower Jordan Valley and its adjacent mountain slopes, the Irano-Turanian associations of this enclave have but little space to develop in typical forms and in typical floristical composition. Many Mediterranean and Saharo-Sindian plants penetrate into these Irano-Turanian associations.

(2) The Negeb (the near Negeb). Associations of *Artemision Herbae albae* dominate here. A great part of this Irano-Turanian territory is under cultivation (extensive cultivation of barley) and its natural vegetation is uncertain.

(3) The Irano-Turanian part of Transjordan. The major part of Transjordan E of the Hedjaz railway belongs to the Syrian Desert; we shall consider it on another occasion when dealing with the vegetation of the Syrian Desert. W of the Hedjaz railway, a great part of Transjordan belongs to the Irano-Turanian territory. From our investigations so far three principal subdivisions can be designated in this territory. In the N we have encountered vestiges of the extremely interesting Irano-Turanian open forest of *Pistacia atlantica*. The middle and largest subdivision is dominated by one or two types of *Artemision Herbae albae* (*Artemisia Herba alba*—*Rheum Ribes* is the principle). Associations of *Haloxylon articulatae* are also rather common. The last subdivision is the high plateau W and SW of Ma'an. This plateau is distinguished by some vestiges of a type of an open forest where *Juniperus phoenicea* grows together with *Artemisia Herba alba* etc. A not less interesting association is that of

Artemisia Herba alba—*Astragalus adpressiusculus* where groups of *Crataegus Azarolus* are meet with here and there. It is on this plateau also that we discovered a series of plants of importance for the elucidation of the history of transjordanian vegetation (*Hedera Helix*, *Prunus prostrata*, *Astragalus adpressiusculus* etc.).

III. SAHARO-SINDIAN TERRITORIES.

There are three of four Saharo-Sindian territories of Palestine :

(1) Lower Jordan Valley and the adjacent lower slopes of the mountains. The banks of the Jordan river are clothed chiefly by a riparian forest of *Populion euphraticae*, which has been insufficiently studied. In the plains of the Jordan Valley the associations of *Suaedion palaestinae* (especially important are different subassociations of *Suaedetum palaestinae*) and *Salsolion tetrandrae* predominate. The mountains surrounding the Jordan Valley are dominated by different types of *Suaedetum asphalticae*, associations of *Gymnocarpion fruticosi* and *Chenoleion arabicae*.

(2) The Valley of 'Araba. The vegetation of 'Araba is almost unknown. Our 2 or 3 short trips to this valley have revealed that the Sudano-Decanian element which is encountered here and there in the Lower Jordan Valley, occasionally true enclaves (Erg, 1931) and which belongs to the Sudano-Decanian *Acacietalia tortilis* (its alliance *Acacion palaestinae*), is here still more accentuated. A quasi climatological association of *Acacion palaestinae* with *A. tortilis* as the dominant tree, is encountered here and there. As in a true Saharo-Sindian territory the climatic associations are here few in number and poorly developed.

(3) The far Negeb. In its northern part the climatic association of *Zygophylletum dumosi*, is the most prominent. *Gymnocarpetum fruticosi* is also encountered but rarely. In the southern part climatic associations are poorly developed or almost absent. Edaphical associations are bound especially to the Wadis.

(4) The Saharo-Sindian territory of Transjordan. *Zygophylletum dumosi* is extremely rare. *Haloxyletum salicornicum* is found only in this part. Associations of *Chenoleion arabicae* and *Salsolion tetrandrae* are among the most common.

The spacial succession of the different associations on crossing from one territory to another is of a surprising regularity, thus permitting a phytosociological criterion in the demarcation of the different phytogeographical territories.

The border line of the Mediterranean and Irano-Turanian ter-

ritories in Palestine runs principally along *Poterietum spinosi* (its variation "*orientale*") on the one hand and the associations of *Artemision Herbae albae* and *Retamo-Phlomion brachyodontis* on the other. Some transitional associations of lesser importance occupy comparatively small transitional areas, characterized by transitional ecological conditions, e.g. *Salvietum graveolentis*, *Echinopetum Blancheanae* etc. However, by their floristical composition they are Irano-Turanian rather than Mediterranean associations.

The border line of the Irano-Turanian and Saharo-Sindian territories is occupied especially by the associations of *Noeion mucronatae*, *Haloxylion articulatae* and *Artemision Herbae albae* on the one hand, by the associations of *Suaedion asphalticae*, *Chenoleion arabicae*, *Gymnocarpion fruticosi* and even by *Zygophylletum dumosi*, the most characteristic Saharo-Sindian association of Palestine, on the other. Different types of *Salsoletum villosae*, of *Anabasis articulata*—*Zilla myagroides*, of *Reaumurietum palaestinae* and of *Atriplicetum palaestinae* are geographically, ecologically and floristically transitional Irano-Turanian—Saharo-Sindian associations of Palestine.

It will be appropriate to add some general phytogeographical remarks here.

Notwithstanding the fact that phytogeography is already an old branch of botany there are still many important points of disagreement. One of them is the rather vague demarcation of the studies in historical phytogeography, which aim at the origin and development of floras and vegetations, from studies of the descriptive floristical-ecological phytogeography, the principle aim of which is to subdivide the vegetation of the world into more or less natural units of a decreasing degree of importance. It seems to me that this lack of clarity is the reason why the independency of the Mediterranean, Irano-Turanian and Saharo Sindian regions is still contested by different botanists. ENGLER's old conception of the large Mediterranean region stretching over forest countries around the Mediterranean, over the Irano-Turanian steppe countries and Saharo-Sindian deserts, reappears from time to time. To clarify this question, some short trips across Palestine would be advantageous and are to be recommended strongly. One could here study the limits of distribution of hundreds of typical Mediterranean plants, which form the typical Mediterranean Maqui, Garigue, Batha etc. Only a few km's farther the typical Irano-Turanian steppe associations may be studied, and scarcely 20 minutes far-

ther by car one passes into a territory dominated by a typical Saharo-Sindian vegetation. The Jerusalem University area is one of the most interesting points for such observations.

During the last ten to fifteen years the role of Russian botanists has been very important in clearing up the essential characteristics of the Irano-Turanian region through research, especially in Turkestan and Transcaucasia. Russian literature is thus indispensable to every one who intends to deal with this phytogeographical region and its subdivision. Unfortunately, the Russian botanists seem to be insufficiently acquainted with the true Mediterranean vegetation and with its ecology; and for this reason they often attribute Anatolia, Persia, Mesopotamia and the whole of Syria and Palestine to the Mediterranean region, to the Mediterranean countries etc.

In this regard it seems to me that the term "Old Mediterranean Region", proposed by POPOV (1927, 1928-29) and largely accepted in Russia should be restricted to historical phytogeography only, in order to avoid a confusion of conceptions. It is certain that the countries surrounding the tertiary Tethis possess more or less uniform ecological conditions as well as a more or less uniform flora and vegetation, vestiges of which are largely distributed in the Mediterranean, Irano-Turanian and Saharo-Sindian regions. Evolution, however, has since brought about a sharp differentiation in the ecology and vegetation of these regions. It therefore seems reasonable to us to propose the term "Tethis" region, vegetation, ecology etc. for the historical phytogeography, retaining the term Mediterranean region, vegetation, element, ecology etc. only for the countries surrounding the Mediterranean Sea and dominated by the Mediterranean plant associations with their social climax (forest) associations.

The question as to what is the best criterion for the demarcation of phytogeographical territories is still open to discussion. Many phytogeographers, especially in France, think they have such a criterion in more or less complicated climatic formulae. I recall one of the most successful and best known it is that of EMBERGER (1930, 1932). Without denying the great utility of such formulae in phytogeographical studies¹, we deem it necessary to warn our confrères against using such formulae as the principal method for phytogeographical

¹ See for example the recent work of DE PHILIPPIS (1937); there the different climatic formulae are also discussed.

subdivisions. Exact floristical study, the knowledge of the geographical distribution and ecological requirements of the species (linneons) and their forms, by personal experience as far as possible, the study of associations and their distribution were and still are the most important bases for establishing phytogeographical subdivisions and their delimitation.

Finally a short remark concerning the method to be employed in phytosociological studies. The method of BRAUN-BLANQUET, Montpellier, which seemed the best was followed principally. But I do not believe that the results of phytosociological studies will differ much if another method is employed. It is largely accepted by the phytosociologists of all schools that vegetation is sharply distinguished according to ecological conditions and that in comparatively limited geographical areas the plots of vegetations of similar ecological stations are more or less similar. It is only the clearness of expression of this similarity that depends on the method employed.

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THE EFFECT OF HETERO-AUXIN ON ROOT FORMATION BY CUTTINGS AND ON GRAFTING

PART I.

BY M. EVENARI (W. SCHWARZ) AND E. KONIS

(With Plates I, II and III)

The researches of LAIBACH (1935), COOPER (1936), GOUWENTAK and HELLINGA (1936), and HITCHCOCK and ZIMMERMAN (1936) have shown that the growth substances may prove to be of considerable practical value to horticulture. The common aim of these workers was a better and quicker rooting of cuttings. As JOST (1937) has pointed out, however, it is not certain "ob auch solche Pflanzen, die ohne Wuchsstoff schwer oder gar nicht wurzeln, durch ihn dazu gezwungen werden koennen."

There is a likelihood also that it will be possible to use the growth substances in horticulture for other purposes than the rooting of cuttings. It is now known that the growth substances not only cause root formation but also stimulate the formation of callus (LAIBACH-FISCHNISCH, 1935; ROGENHOFER, 1936) and govern the correlation between lateral buds and shoots ("Korrelationstraeger" of WENT, 1936).

In the work to be described, therefore, our aim was to test the usefulness of the growth substances for:

- (1) inducing a quicker and more abundant root formation in cuttings which normally require long periods to form roots,
- (2) stimulating root formation in cuttings which do not normally root,
- (3) obtaining a union of stock and scion in graftings which normally do not give a union or improving the union in graftings which normally give an unsatisfactory union, and
- (4) preventing premature bud development in cuttings or scions and controlling the growth of the buds.

For success in these purposes, the dose of the growth substances and the manner of their application are of utmost importance. For every species and variety the optimal dose must be separately determined.

In applying the growth substances, three possible methods present themselves, viz:

(1) The growth substances may be mixed with lanolin, and the mixture thus obtained applied to the plants (LAIBACH's method, 1935).

(2) The growth substances may be dissolved and the basal ends of cuttings placed in the solutions obtained (method of HITCHCOCK and ZIMMERMAN, 1936).

(3) Crystals of the growth substances may be applied directly to the tissues of the shoots.

METHODS

Among the known growth substances, only β -indoleacetic acid, or hetero-auxin (H.A.), was tested. This compound as DAVIS, ATKINS and HUDSON (1937) have shown is a most effective stimulator of root formation. After being treated the cuttings were placed in sand so that their basal cut surfaces were buried to a depth of 2—3 cm. The sand was heated by bottom heat to 28° C. In the following Tables this treatment is denoted by the initials H.T. In other experiments cuttings were completely buried in sand which was not heated, and this treatment is denoted by L.T. (third column of Tables I and II).

The lanolin preparations of H.A. were prepared as follows :

Preparation 1.: 232 mg of the synthetic crystalline compound were dissolved in 100 cc of distilled water and very little ethyl-alcohol (see HITCHCOCK and ZIMMERMAN, 1936) and 25 cc of this solution were mixed with 50 g of pure waterfree lanolin.

Preparation 2.: 50 g of lanolin were mixed with 25 cc of distilled water. (This preparation was used in check-experiments).

Preparation 3.: 320 mg of H.A. were dissolved in 100 cc of water and 25 cc of this solution were mixed up with 50 g lanolin. About 1 g of these preparations was used on the cuttings or graftings. With prep. 1: 1,2 mg of H.A. and with prep. 3: 1,6 mg H.A. were applied per cutting.

The different solutions of H.A. were freshly prepared for experiment according to the method of HITCHCOCK and ZIMMERMAN (1936), and the cuttings were placed with their basal cut surface in the test solutions.

EXPERIMENTAL

The experimental results are tabulated in Table I and II. Table I contains the results of the experiments with cuttings, Table II those of the experiments with graftings.

(a) *Experiments with Ficus carica.*

The results of our experiments with fig-cuttings may be summarized as follows :

(1) Cuttings whose terminal buds are removed lose their capacity to form roots.

(2) Cuttings whose terminal buds have been removed regain their rooting capacity on being treated with H.A. The number of roots formed by plants thus treated is greater than the number formed by untreated possessing intact terminal buds.

(3) If cuttings with terminal buds are treated with H.A. laterally from the apical end, the percentage of cuttings which root but not the number of roots per cutting is increased.

(4) The application of H.A. to cuttings with terminal buds retards the development of the terminal buds. On cuttings without terminal buds, the delay is much less pronounced.

(5) Treatment with H.A. shortens the time period required for the formation of roots.

(6) Treatment with H.A. results in a marked increase of the average root length.

(7) The lateral application of H.A. above the basal cut surface of cuttings with terminal buds causes a slight increase in the number of roots which form, but reduces percentage of cuttings which root. When cuttings are treated in the same way with crystals of H.A. a similar result is obtained. With the crystals, callus formation, also, is markedly increased.

In untreated cuttings, development of buds and formation of roots are correlated phenomena, roots appear only in cuttings which develop terminal or lateral buds. This correlation is abolished by the application of H.A. to the apical cut surface. By this treatment root formation is induced in cuttings which do not develop buds.

(b) *Experiments with Olea europaea.*

The results of the experiments with cuttings of the olive tree are summed up as follows :

(1) Treatment with H.A. causes a strong formation of callus. This formation is localized on the treated spot. The development of buds is totally inhibited.

(2) The H.A. induces precocious shedding of leaves.

TABLE I.

Number of experiment	Plant examined	Treatment and remarks				Number of specimens tested	Beginning of experiment	End of experiment	Total number of roots formed	Length of longest root in cm	Number of rooted cuttings	Number of cuttings with callus formed	Number of cuttings with buds developed
		(1)	(2)	(3)	(4)								
1	<i>Ficus Carica</i>	H.T.	a	Leafless cuttings, stripped of terminal buds, prep. 1 on apical above basal cut surface.	20	9.2.37	5.3.37	460	5,4	20	20 (+ +)	8	
2	"	H.T.	b	Check, prep. 2 on apical cut surface. (Photograph in PL. I.A.).	20	"	"	40	1,2	10	20 (+)	10	
			a	Bark removed from area of 1 sq. cm. beneath terminal buds. Prep. 1 on stripped spot.	20	"	"	270	6,5	20	—	8	
		b	Check, prep. 2 on stripped spot.	20	"	"	230	3	14	—	17		
3	"	H.T.	a	Bark removed from area of 1 sq. cm. above basal cut surface. Exposed surface treated with prep. 1.	20	"	"	140	—	8	—	8	
			b	Check, stripped spot treated with prep. 2.	20	"	"	72	—	12	—	12	
		c	Bark slit, crystals of H.A. placed in the rifts.	20	"	"	40	—	4	—	4		

4	<i>Olea europaea</i>	H.T.	a	Prep. 1 on apical cut surface. Cuttings shed their leaves (Photograph in PL. I.B.). Check, prep. 2 on apical cut surface.	20	10.2.37	26.5.37	—	—	20 (+ + +)	—	20 (9)
			b		20	"	"	—	—	—	—	
5	"	H.T.	a	Bark slit above basal cut surface. Crystals of H.A. placed in rift. Cuttings shed their leaves.	20	10.2.37	5.3.37	—	—	20 (+ + +)	—	—
			b	Check, bark slit but not treated.	20	"	"	—	—	—	—	—
6	<i>Pirus malus</i> "Doucin"	H.T.	a	Rings of bark removed above basal cut surface. Rings treated with prep. 1.	35	23.2.37	20.4.37	—	—	21 (+ + +) 7 (+ +)	—	—
			b	Check, rings treated with prep. 2.	35	"	"	—	—	10 (+ +) 20 (+)	—	—
7	"	H.T.	a	Basal cut surfaces treated with prep. 3.	50	29.3.37	5.4.37	—	—	50 (+ + +)	14	—
			b	Check, basal cut surfaces treated with prep. 2.	50	"	"	—	—	50 (+)	20	—
8	"	H.T.	a	Placed for period of 45 h' in 15 mg % of solution (15 mg in 100 cc of water) of H.A.	20	9.3.37	5.4.37	5	—	12 (+ + +) 8 (±)	5	—
			b	Check, placed for period of 45 h' in water.	20	"	"	—	—	7 (+)	—	—
										8 (+ + +) 12 (+ +)	—	—
9	<i>Pirus malus</i> "Hashabi"	H.T.	a	Treated as described under 6a.	20	23.2.37	9.3.37	—	—	5 (+ +) 8 (+) 2 (±)	—	—
			b	Check, treated as described under 6b.	20	"	"	—	—	—	—	—

TABLE I. (continued)

(1) Number of experiment	(2) Plant examined	(3) Treatment and remarks	(4) Number of specimens tested	(5) Beginning of experiment	(6) End of experiment	(7) Total number of roots formed	(8) Length of longest root in cm	(9) Number of rooted cuttings	(10) Number of cuttings with callus formed	(11) Number of cuttings with buds developed
10	<i>Cydonia vulgaris</i>	H.T. a Treated as described under 6a. b Check, treated as described under 6b.	20	"	"	10	10	6	16 (+ +) 4 (+)	—
11	<i>Vitis vinifera</i> "Hamburger Muskat"	H.T. a Treated on apical cut surface with prep. 1. b Check, treated on apical cut surface with prep. 2.	20	"	"	—	—	—	2 (+) 7 (+)	—
12	<i>Vitis vinifera</i> "Hamburger Muskat"	H.T. a Bark slit open above basal cut surface, crystal of H.A. inserted into rift. b Check, bark slit open, but not treated.	20	9.2.37	5.3.37	135	—	20	—	4 (5)
13	<i>Vitis vinifera</i> "Chasselas"	L.T. a H.A.-crystals on apical cut surface. Roots emerged mostly beneath apical cut surface (See PL. II. A.). b H.A.-crystals and prep. 2 on apical cut surface. Roots emerged mostly beneath apical cut surface. c Untreated check. d Prep. 2 on apical cut surface.	20	12.2.37	23.3.37	14	—	5	—	5
			20	"	"	—	—	—	—	12
			20	17.3.37	12.5.37	904	30	20	—	2
			20	"	"	1220	33	20	—	3 [3]
			20	"	"	246	23	20	—	20 (36) [25]
			20	"	"	320	24	20	—	18 (40)

14	<i>Vitis vinifera</i> "Rupestris du Lot"	L.T.	a	Prep. 3 on basal cut surface. Untreated check.	20	"	20	21.3.37	12.5.37	116	25	16	—	20 (78)[35]
			b		20	"	"	"	"	27	7	3	—	14 (39)[4]
15	<i>Vitis vinifera</i> "Mourvedre x Rupestris 1202"	L.T.	a	Treated as described under 14 a.	20	"	"	"	"	307	18	20	—	18 (36)[20]
			b	Untreated check.	20	"	"	"	"	62	10	15	—	18 (39)[7]
16	<i>Vitis vinifera</i> "Berlandieri 41B"	L.T.	a	Treated as described under 14 a.	20	"	"	"	"	21	12	11	—	17 (24)[3.5]
			b	Untreated check.	20	"	"	"	"	—	—	—	—	10 (18)[2]
17	<i>Vitis vinifera</i> "Hamburger Muskat"	L.T.	a	Placed for period of 11 h' in 15 mg % solution of H.A.	20	11.3.37	20.4.37	72	14	18	—	—	—	16 (16)
			b	Placed for period of 48 h' in 15 mg % solution of H.A.	20	"	"	192	25	19	—	—	—	18 (22)
			c	Check, placed for period of 11 h' in water.	20	"	"	85	22	17	—	—	—	18 (23)
			d	Check, placed for period of 48 h' in water.	20	"	"	164	—	17	—	—	—	20 (32)
18	<i>Vitis vinifera</i> "Rupestris 1202"	L.T.	a	Placed for period of 44 h' in 15 mg % solution of H.A.	20	21.3.37	12.5.37	395	25	20	—	—	—	18 (37)[30]
			b	Check, placed for period of 44 h' in water.	20	"	"	56	10	16	—	—	—	19 (44)[7]
19	<i>Vitis vinifera</i> "Berlandieri 41B"	L.T.	a	Treated as described under 18 a.	20	"	"	118	10	18	—	—	—	18 (22)[5]
			b	Check, treated as described under 18 b.	20	"	"	—	—	—	—	—	—	10 (18)[2]
20	<i>Vitis vinifera</i> "Rupestris du Lot"	L.T.	a	Treated as described under 18 a.	20	"	"	11	—	4	—	—	—	5 (8)
			b	Check, treated as described under 18 b.	20	"	"	9	—	4	—	—	—	16 (40)

TABLE I presents the date on the rooting of cuttings. In column 11 the figures in parenthesis () indicate the total number of buds developed, the figures in parenthesis [] the length of the longest shoot. In column 10 the + signs indicate roughly the degree of the callus development, + indicate a small callus.

TABLE II.

Number of experiment	Stock	Section	Treatment and remarks	(5) Number of specimens tested	(6) Beginning of experiment	(7) End of experiment	(8) Number of plants with satisfactory union of stock and scion	(9) Number of plants rooted	(10) Number of roots formed	(11) Number of specimens with buds developed
(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
21	<i>Pirus malus</i> "Doucín"	<i>Pirus malus</i> "Grand Alexandre"	L.T. a English grafting of vine was used (whip grafting on cut stock). Cut surface of stock and scion treated with prep. 1. b Check, grafting cut surface treated with prep. 2.	40 33	26.2.37 "	18.3.37 "	34 12	— —	— —	— —
22	<i>Prunus Mahaleb</i>	<i>Prunus cerasus</i> "Lady Windsor"	L.T. a Head graftings (whip grafting on rooted stock). Grafting cut surface treated with prep. 3. b Grafting cut surface treated with crystals of H.A. c Untreated check.	20 20 20	19.3.37 " "	23.5.37 " "	1 1 2	— — —	— — —	— — —
23	<i>Pirus communis</i>	<i>Pirus communis</i> "Beurre Hardy"	L.T. a Treated as described under 22 a. b Treated as described under 22 b. c Check untreated.	20 20 20	" " "	" " "	7 1 15	— — —	— — —	— — —

24	<i>Vitis vinifera</i> "Hamburger Muskat"	L.T.	<i>Vitis vinifera</i> "Hamburger Muskat"	a	English grafting. Grafting cut surface treated with crystals of H.A.	20	17.3.37	5.4.37	20	20	256	—
				b	Grafting cut surface treated with prep. 2.	20	"	"	4	14	36	—
				c	Untreated check.	20	"	"	—	9	63	—
25	<i>Vitis vinifera</i> "Rupestris 1202"	L.T.	<i>Vitis vinifera</i> "Chasselas"	a	English grafting. Grafting cut surface treated with prep. 3.	20	21.3.37	12.5.37	20	20(15)	243	5(18)
				b	Bark surrounding grafting place removed. Prep. 3 applied to barkless spots.	20	"	"	—	10(4)	47	—
				c	Grafting cut surface treated with crystals of H.A.	20	"	"	20	20(20)	1142	8(5)
				d	Untreated check.	20	"	"	—	16(20)	83	—
26	<i>Vitis vinifera</i> "Berlandieri 41B"	L.T.	<i>Vitis vinifera</i> "Chasselas"	a	Treated as described under 25 a.	20	"	"	15	4	—	3
				b	Treated as described under 25 c.	20	"	"	20	20	660	5
				c	Untreated check.	20	"	"	—	—	—	—

TABLE II presents the date on graftings. The figures in parenthesis in columns 9 represent the length of the longest root in cm. The figures in parenthesis in column 11 represent the length of the longest shoot in cm.

(c) *Experiments with different Rosaceae.*

The experiments with *Rosaceae* were partly conducted in the tree nursery of Ramat Rachel near Jerusalem. Our thanks are due to BEN-ZION VANSKY and LILY TAUBER for their generous help.

The results in respect of *Rosaceae* of the 11 experiments conducted may be summed up as follows:

(1) In all plants examined the H.A.-treatment resulted in a strong formation of callus.

(2) The influence of the H.A.-treatment is greatest with the apple variety "Kaiser" and least with the variety "Hashabi".

(3) H.A. stimulates the formation of roots but very slightly if at all. In one case the H.A.-treatment inhibited the root formation (Doucín, exp. 7.).

(4) H.A. treatment inhibits the development of buds.

(5) Union of stock and scion is bettered by treatment with H.A.-preparations in the case of graftings of apple varieties "Grand Alexandre" on "Doucín".

(6) In head grafting of cherry variety "Lady Windsor" on *Prunus Mahaleb* and pear variety "Beurre Hardy" on *Pirus communis* the H.A.-treatment hampers the union of the two graft components.

(d) *Experiments with Vitis vinifera.*

Our first experiments on auxin in relation to its influence on vine were conducted during 1935-36 in collaboration with our late friend GERSHON MOSHEOV. The favorable results obtained in these experiments which were carried out with auxin prepared by us led us to resume our investigations in 1937.

In the following grafting experiments the so called "English graft" was used. We found it possible to omit the usual bandaging of the wound. Our thanks are due to CHANNAH HOOPER for their help in preparing the graftings.

The results obtained in experiments with vine may be summarized as follows:

(1) H.A.-treatment increases the percentage of rooting cuttings (rooting percentage) and length and number of roots per cutting of all the varieties.

(2) On "Rupestris 1202" lanolin preparations of H.A., H.A. solutions, and H.A. crystals exert the same stimulating effect on the

rooting percentage. They cause a rise from 75-80% to 100%. The number of roots is increased most markedly by crystals (57 roots per cutting), but to a less marked degree by solutions (19 roots) and the lanolin preparation. When the lanolin preparation is laterally applied to the apical end the rooting percentage is reduced (50%).

(3) In "Berlandieri 41 B" treatment with crystals is more effective than treatment with solutions of H.A. and lanolin preparations. The response of this variety to H.A. treatment is far more marked than that of all other varieties examined. In "Berlandieri 41 B" the rooting percentage of cuttings is increased by treatment with H.A. crystals from 0% to 100%.

(4) In "Rupestris du Lot" H.A. solutions did not prove effective. Lanolin preparations of H.A. increase the rooting percentage from 15-20% to 80%.

(5) In "Chasselas" the control itself gives 100% rooting. In respect to the number of roots formed, the following sequence of effectiveness was observed: Crystals combined with lanolin preparations 2—61 roots; crystals alone — 47 roots; lanolin preparations 2 alone — 16 roots; check — 12 roots. It is important to note that lanolin itself without H.A. stimulates the root formation. This observation was further made in other experiments.

(6) In "Hamburger Muskat" crystals and lanolin preparations of H.A. applied to the apical end increase the rooting percentage to 100%. Solutions of H.A. are less effective.

(7) Where roots appear on both ends of the cutting, the relationship of the number of roots which emerge on the apical and basal end of cuttings is an inverse proportion. The greater the number of roots formed on the apical end the less their number on the basal cut surface, and vice versa.

(8) The development of lateral buds is inhibited by apical application of lanolin preparations, by apical and basal application of crystals and by solutions. (A solitary exception was observed in exp. 21). The maximal inhibition is obtained with crystals. When lanolin preparations of H.A. are basally applied to the cuttings a stimulation of the lateral bud development is obtained. By such treatment both the percentage of cuttings which develop buds and the length of the lateral shoots thus formed are increased.

(9) In all varieties the union of stock and scion is markedly

bettered by H.A. treatment.¹ The time required for good union is shortened. The quantity of callus formed is increased. Crystals are more effective in this respect than lanolin preparations of H.A.

(10) The H.A. treatments inhibits the development of buds by the scion of a grafting.

(11) The heating of vine graftings during two weeks after grafting (HOCHBERG and GRIMTLICHT, 1937) which is a common practice in Palestine is rendered unnecessary by the H.A. treatment.

DISCUSSION

The experiments conducted during the course of the present investigation show that H.A. treatment may be useful in the vegetative propagation of certain plant species (fig tree and vine) and in grafting (vine). In this connection the following principles must be observed :

(1) The effectiveness of the growth substances applied depends as has been already pointed out by HITCHCOCK and ZIMMERMAN (1936)

¹ In 1938 there were grafted in Ein-Harod on a large scale vines by means of hetero-auxin under the supervision of Mr D. ZIRKIN. The results obtained were very successful.

EXPLANATION OF PLATES.

PLATE I. A.: *Ficus carica*, experiment 1. The upper row represents 1b, the lower row 1a. The last two specimens of the lower row show roots emerging from the apical cut surface.

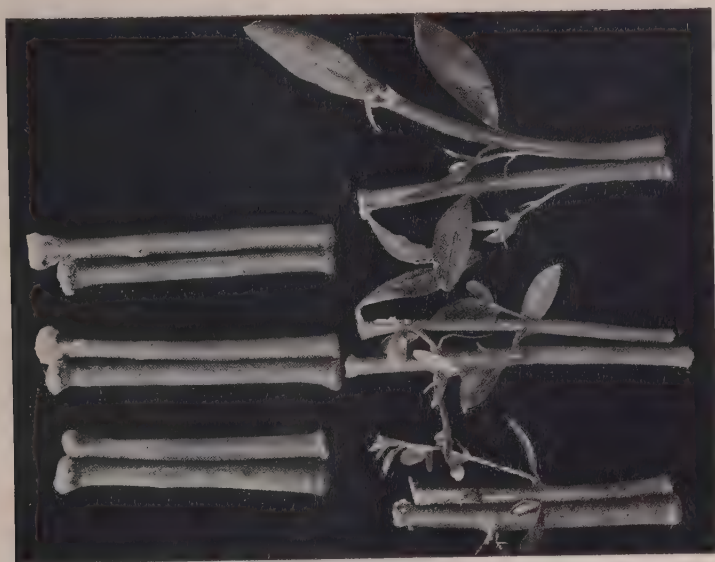
B.: Olive tree, experiment 4. The upper row represents 4a, the lower 4b.

PLATE II. A.: *Vitis vinifera*, experiment 13. 4 specimens of 13b. are represented.

B.: *Vitis vinifera*, experiment 25 (on the 20.IV.). The upper row represents 25c, the lower row 25d.

PLATE III. A.: The same experiment as represented on PLATE II. B., but photographed on the 12.V.

B.: *Vitis vinifera*, experiment 26. From left to right: 3 specimens of 26c with removed scions in order to show the complete lack of callus, two specimens of 26b, two specimens of 26a. In the last specimen on the right side the scion was removed in order to show the enormous callus formed on the grafting cut surface.

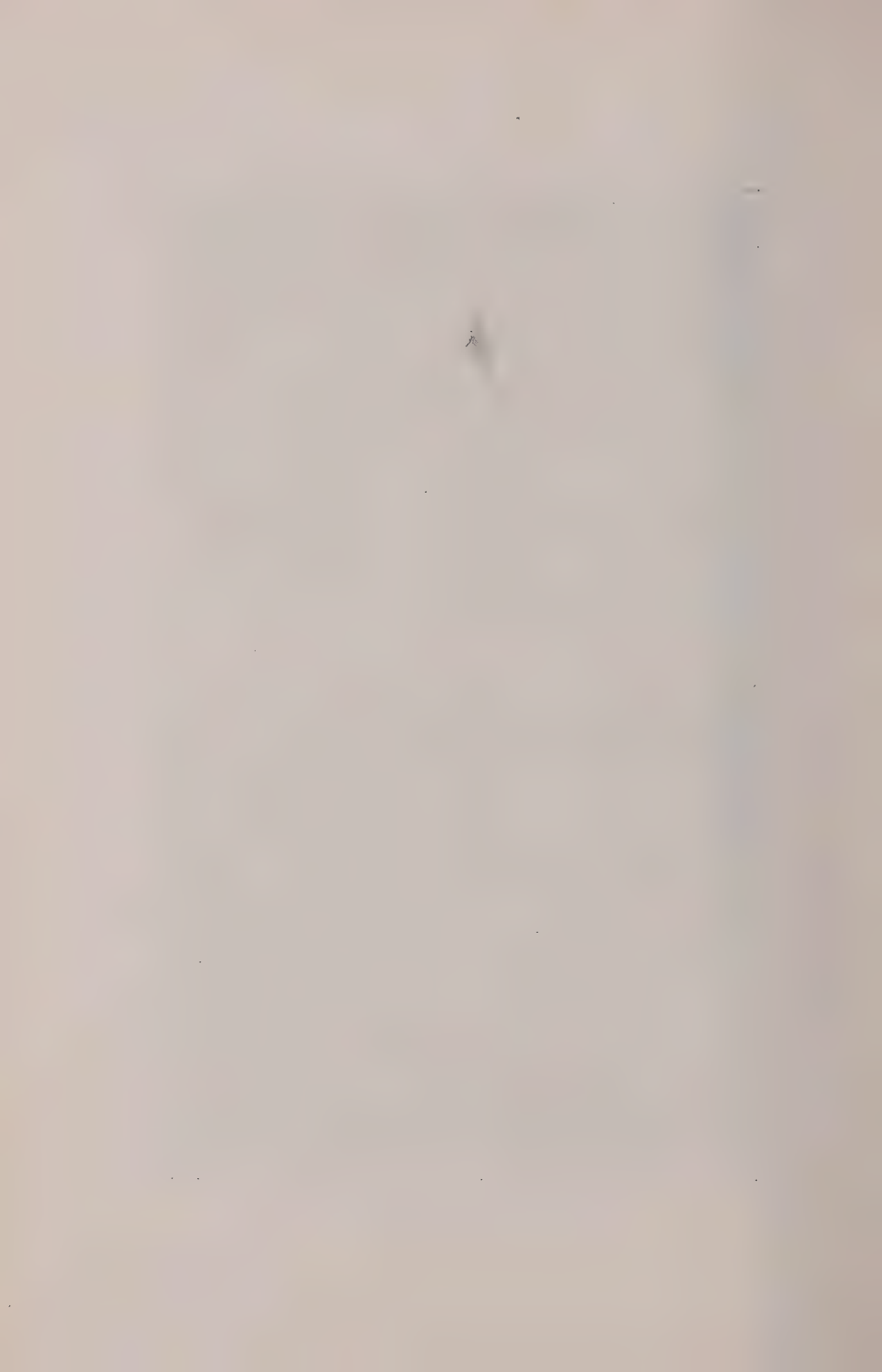


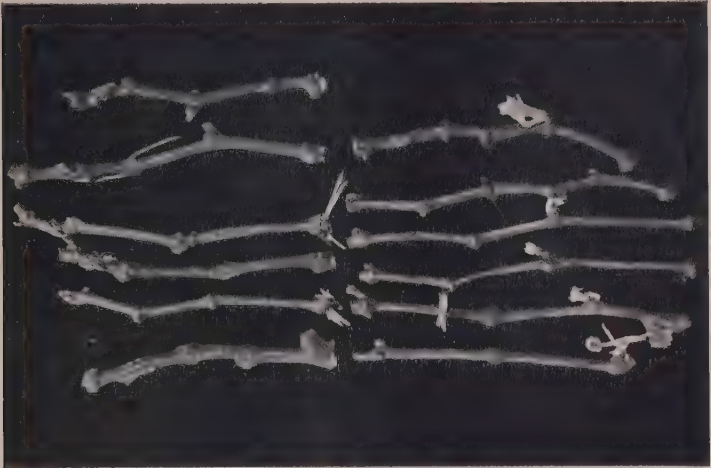
B



A

EVENARI AND KONIS — EFFECT OF HETERO-AUXIN ON
ROOT FORMATION



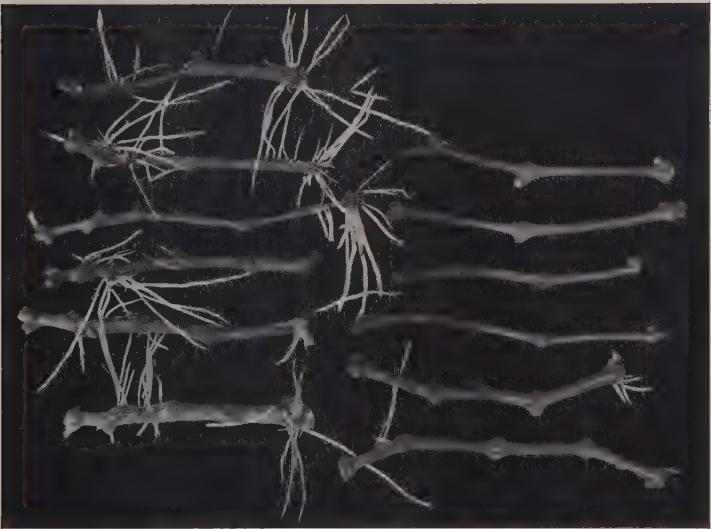


B



A

EVENARI AND KONIS — EFFECT OF HETERO-AUXIN ON
ROOT FORMATION



EVENARI AND KONIS — EFFECT OF HETERO-AUXIN ON
ROOT FORMATION

upon the method of their application to the plant. No known method is of general applicability. For each species and for each variety the best method of application and the optimal dose has separately to be found.

(2) It is of paramount importance that the dose of growth substance applied is one which while it stimulates the formation of root does not excessively inhibit the development of the buds. It seems advisable for this reason to apply the growth substances at the basal end of the cuttings even though other methods of application may be of greater effectiveness for inducing root formation. In order to prevent a pronounced inhibition of bud development in graftings the use of long scions appears to be advisable. The greater the distance between the point of application of the growth substance and apical end of the scion the smaller the inhibition obtained.

Not all plants react in the same way to growth substances. In some cases in which roots are not formed without H.A. treatment application of H.A. did not induce root formation. In each species the callus formation is enormously increased by the H.A. treatment. Data have been obtained also which tend in general to confirm the conclusion that a reverse proportionality exists in certain cases between root and callus formation. Why the H.A. induces root formation in certain cases but not in other is obscure. Possibly H.A. acts upon the plasma as an irritant (see FITTING 1936). If this is so, it may be that in certain cases the plasma lack this special irritability to H.A. and then roots are not formed. Possibly also the growth substances act upon the transport of other special root forming factors (see WENT 1936, 1938), which latter may be lacking in certain cases. No decision on this question is possible from our results. Also it is not clear why the H.A. stimulates the union of stock and scion in the "English graft" but fails to do so in head grafting. The precocious shedding of leaves by olive tree cuttings treated with H.A. is a new observation on the effect of H.A.

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ALGUES DES SOURCES THERMALES DE KALLIRHOE (TRANSJORDANIE)

PAR P. FRÉMY (Saint-Lô) ET T. RAYSS (Jérusalem)

(Avec 5 figures dans le texte)

Les sources thermales sont abondantes en Palestine et leur origine est liée à l'histoire géologique de ce pays. Elles sont disposées en grande partie de part et d'autre de la grande dépression qui traverse la Palestine du Nord au Sud et dans laquelle se trouvent le lac de Génésareth, la vallée du Jourdain et la Mer Morte. Cette dépression s'est produite à la suite des événements tectoniques qui ont eu lieu à la fin du Pliocène et au commencement du Quaternaire et c'est aussi à cette époque que les sources thermales se sont formées. Cette disposition particulière des sources thermales en Palestine est bien visible sur la carte du Dr. LACHMANN (1933) que nous reproduisons d'une façon un peu simplifiée (fig. 1).

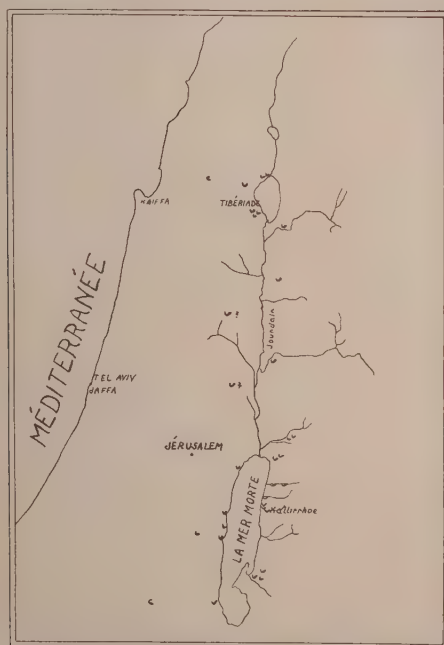


Fig. 1. Carte géographique de la Palestine avec l'indication des sources thermales. v = source thermale.

Jusqu'à présent personne, à notre connaissance, ne s'est occupé de la végétation algale de ces sources et cette contribution sera probablement la première pour la connaissance des Algues de toute cette région. Aussi avons-nous décidé de commencer la série de nos études sur les Algues de Palestine par les Algues des sources thermales et notamment par celles de Hammam Zarah ou, d'après BLANCKENHORN (1912), Kallirrhoë ; ce nom de Kallirrhoë est du reste inscrit sur le débarcadère de cet endroit. Ces sources se trouvent sur le bord oriental de la Mer Morte, au Sud de l'embouchure de la rivière Zerka Ma'in, dans une brusque dépression du plateau de Moab. Dans l'antiquité les sources de Kallirrhoë ont joui d'une grande réputation thérapeutique et sont citées par JOSEPHUS FLAVIUS comme possédant des propriétés curatives, balnéologiques et digestives. Ce nom "Kallirrhoë", ce qui signifie en grec "jolie source", leur a été donné par HERODE LE GRAND qui fit construire à leur voisinage des installations balnéaires et des édifices somptueux. Il n'y a aucune trace d'installation d'autrefois à Kallirrhoë de notre temps, mais plus à Nord, dans le Wadi de la rivière Zerka Ma'in, à quelques kilomètres de son embouchure dans la Mer Morte, se trouvent des eaux sulfureuses chaudes et, à leur voisinage, se trouvent des vestiges d'anciennes routes et des ruines romaines ; quelques savants pensent qu'ancien Kallirrhoë a été situé là (Prof. PICARD). Kallirrhoë est mentionné aussi par PLINIE (I-er s. après J.C.) et ensuite par PTOLOME LE GEOGRAPHE (2-ème s. après J.C.). Mais à partir de cette date et jusqu'au XIX s. on ne trouve dans la littérature aucune mention de cet endroit (BRZEZINSKI, 1934).

A l'heure qu'il est, se trouvent à Kallirrhoë (Hammam Zarah) plusieurs sources minérales, les unes à eau froide, les autres à eau chaude (jusqu'à 60°), qui serpentent entre les touffes calcaires et se réunissent ensuite en un ruisseau plus grand qui tombe dans la Mer Morte. Non loin de l'embouchure se trouve un petit bassin (de 2 mètres carrée environ) où les touristes se baignent encore maintenant. Selon SCHROETTER (1924), la température y est de 42°, la saveur de l'eau est douceâtre et elle n'a pas d'odeur ; la teneur en chlorures est de 1 gr 046 par litre. LARTET (1866), d'après les analyses faites par H. TERREIL, indique que cette eau renferme 0 gr 716 de corps solides dissous par litre et que son poids spécifique est 1,00082. D'après BRZEZINSKI (1934), sa saveur est saline et très légèrement amère ; elle est cependant potable et paraît avoir des effets très favorables sur la diges-

tion. "On y relève une grande proportion de soufre et parmi les nombreux autres sels, on remarque la présence de bromure". Mais, remarque cet auteur, "les résultats scientifiques modernes manquent et il n'y a pas d'analyses chimiques exactes". Du fait, encore à l'heure présente, nos connaissances se limitent à ces données.

Nous avons visité les sources de Kallirrhoë à l'occasion d'une excursion botanique avec les étudiants de l'Université Hébraïque de Jérusalem, le 9 Mars 1936. Nous avons prélevé quatre échantillons numérotés 1, 2, 3, 4, non pas dans le bassin des baigneurs, mais aux quatre endroits différents où les filets d'eau coulaient imperturbablement entre les coussinets d'algues. La température de l'eau variait entre 35° et 40°.

L'échantillon No. 1 a été pris dans un petit cours d'eau tout près du débarcadère ; la température de l'eau a été de 35°. Il contient en suspension dans l'eau les algues suivantes : *Phormidium fragile*, *Ph. laminosum*, *Oscillatoria formosa*, *O. chalybea*.

L'échantillon No. 2 contient les masses d'algues prises au bord de ce même ruisseau. Ces masses sont muqueuses, érugineuses, parfois légèrement incrustées de calcaire. On y trouve : *Merismopedia punctata*, *Aphanocapsa thermalis*, *Chroococcus turgidus*, *Gloeotheca Goepertiana*, *Phormidium tenue*, *Ph. valderianum*, *Ph. lucidum*, *Spirulina labyrinthiformis*, *Hapalosiphon laminosus* f. *microchaetoides*, *Scytonema velutinum*.

L'échantillon No. 3 a été prélevé plus haut, sur la pente, entre les touffes calcaires si caractéristiques de cet endroit. Il renferme des masses grisâtres, fermes, assez fortement incrustées de calcaire et contient : *Aphanocapsa thermalis*, *Phormidium valderianum*, *Scytonema velutinum*.

L'échantillon No. 4 a été pris encore plus haut dans la montagne, dans une petite source dont l'eau avait 40°. Il contient des masses brunâtres ou grisâtres, légèrement incrustées de calcaire, mélangées de petites masses muqueuses, érugineuses, non calcifiées. Comme algues, nous y avons trouvé : *Aphanocapsa thermalis*, *Chroococcus turgidus*, *Ch. minutus*, *Gloeotheca rupestris*, *Phormidium valderianum*, *Cylindrospermum stagonale*.

Toutes les algues énumérées appartiennent aux Cyanophycées. Nous avons vu aussi quelques Diatomées, mais en si petite quantité qu'il ne nous est pas été possible de faire leur détermination.

ETUDE SYSTEMATIQUE

A. CHROOCOCCALES.

Merismopedia punctata Meyen (No. 1)¹—Petites colonies de 4—8 cellules; cellules larges de $3,5\mu$ en moyenne. Très peu abondant.— Espèce vivant le plus souvent dans les eaux douces, signalée cependant ci et là dans les eaux thermales (France, Allemagne, Autriche).

Aphanocapsa thermalis Brügg., Rab., Flor. eur. Alg., II : 50, 1865. (No. 2, 3, 4).— Cellules larges de 3μ en moyenne, densément réunies en colonies plus ou moins importantes, ordinairement dépourvues de téguments, érugineuses, sans forme définie; abondant surtout dans l'échantillon No. 2. Espèce fréquente dans les eaux thermales (Europe, Japon), probablement cosmopolite.

Chroococcus turgidus (Kütz.) Naeg. (No. 2, 4).— Cellules larges de 14—18 μ sans leur tégument, de 18—25 μ avec leur tégument, à contenu parfois violacé; téguments lamelleux ou non [var. *thermalis* (Kütz.) Rab.]; colonies formées le plus souvent de 2 cellules seulement; peu abondant. — Espèce sans doute cosmopolite dans les eaux thermales; très fréquente aussi dans les eaux douces.

Chroococcus minutus (Kütz.) Naeg. (No. 4).— Cellules larges de 5—6 μ sans leur tégument, de 7—9 μ avec leur tégument, à contenu érugineux, téguments homogènes; colonies formées le plus souvent de 2—4 cellules; très peu abondant.— Espèce fréquente dans les eaux douces, plus rare dans les eaux thermales (France, Allemagne, Porto-Rico) où cependant ell est sans doute cosmopolite.

Gloeotheca rupestris, (Lyngb.) Born. in Wittr. et Nordst., Alg. exs., No. 399, 1880 (No. 4).— Cellules cylindriques, à bouts arrondis, larges de 5 μ en moyenne, longues de 12—14 μ à téguments peu lamelleux; colonies formées ordinairement d'un petit nombre (4—8) de cellules; peu abondant. — Signalé çà et là dans les eaux thermales ou à leur voisinage; beaucoup plus fréquent sur les murs ou les rochers humides.

Gloeotheca Goeppertiana (Hilse) Forti, Syll. Alg., V : 62, 1907 (No. 2).— Cellules érugineuses, mesurant en moyenne $2,5 \times 5,5\mu$ téguments lamelleux, colonies formées d'un petit nombre de cellules.— N'avait pas encore été signalé dans les eaux thermales.

¹ Les numéros entre parantèses indiquent les numéros des échantillons.

B. HORMOGONEALES

1. HOMOCYSTEAE.

Phormidium fragile Gom. (No. 1).— Filaments isolés, non réunis en plaques, trichomes épais de $2\ \mu$ en moyenne, articles subcarrés ; forme correspondant exactement à la figure 13 de la planche IV de la deuxième partie de la Monographie des Oscillariées de GOMONT ; assez abondant.— Trouvé assez souvent dans les eaux thermales (France, Italie, Pamir, Argentine) ; vit aussi dans les eaux saumâtres.

Phormidium laminosum (Ag.) Gom. (No. 1).— A l'état de filaments isolés ou de petites plaques ; trichomes épais de $1,5\ \mu$ droits, à sommet très légèrement atténué, à cloisons accompagnées de quatre granules réfringents ; quelques trichomes sont engainés ; assez abondant.— Espèce très répandue dans les eaux thermales du monde entier.

Phormidium tenue Gom. (No. 2).— A l'état de filaments isolés ; trichomes épais de $1,5 - 1,8\ \mu$ non ou à peine rétrécis aux articulations, droits, non atténués au sommet ; quelquefois engainés ; peu abondant. — Cette espèce vit dans les eaux douces, les eaux saumâtres et les eaux thermales où elle est sans doute cosmopolite.

Phormidium valderianum (Delp.) Gom. (No. 2, 3, 4, particulièrement abondant et bien caractérisé dans le No. 3).— Plaques épaisses, élastiques, érugineuses à l'extérieur, ordinairement décolorées à l'intérieur ; trichomes souvent engainés, épais de $2\ \mu$ en moyenne, formés d'articles plus longs que larges, non rétrécis aux articulations, à cloisons bordées de 2 à 4 granules.— Eaux douces et eaux thermales dans lesquelles il est sans doute cosmopolite.

Phormidium lucidum Kütz. (No. 2).— A l'état de filaments isolés et non réunis en plaque, simulant ainsi un *Lyngbia* ; trichomes assez souvent engainés, épais de $7\ \mu$ en moyenne, nettement toruleux, articles très courts ; apex légèrement atténué-capité (fig. 2) ; assez abondant.— Espèce vivant surtout dans les eaux thermales (Italie, Allemagne, Autriche, Hongrie, Amérique du Nord).

Oscillatoria formosa Bory (No. 1).— Trichomes épais de $5\ \mu$ en moyenne, articles environ moitié moins longs que larges, à protoplasma fortement granuleux ; sommet des trichomes courbé-unciné ; peu abondant.— Espèce cosmopolite dans les eaux douces et les eaux thermales.

Oscillatoria chalybea Mart. (No. 1).— Trichomes épais de $8\ \mu$ en moyenne, légèrement rétrécis aux articulations, formés d'articles en-

viron moitié moins longs que larges, à sommet à peine atténué-unciné ; peu abondant.— Fréquent dans les eaux douces et aussi dans les eaux thermales (France, Espagne, Croatie, Argentine).

Spirulina labyrinthiformis (Menegh.) Gom. (No. 2).— Spires épaisses de 2 μ en moyenne, très régulières, à tours contigus ; très peu abondant.— Espèce fréquente dans les eaux douces et saumâtres, et aussi dans les eaux thermales (France, Italie, Algérie, Afrique équatoriale, Amérique du Nord, Argentine ; probablement cosmopolite).

2. ANHOMOCYSTEAE.

Hapalosiphon laminosus Hansg. f. *microchaetoides* Frémy, Annales de Protistologie, V : 188, 1936. (No. 2).— Filaments droits ou peu flexueux, trichomes épais de 2,5—3 μ hétérocystes très rares, spores nombreuses, disposées en séries discontinues le long du trichome, mesurant 4—5 \times 8—10 μ parfois brunâtres ou jaunâtres ; les gaines des filaments sont elles-mêmes parfois jaunâtres (fig. 3) ; assez abondant.— *Hapalosiphon laminosus* est une des espèces les plus caractéristiques des eaux thermales et l'une de celles qui s'y trouvent le plus souvent, mais la répartition et la biologie de la f. *microchaetoides* sont encore complètement inconnues.

Scytonema velutinum (Kütz.) Rab. [= *Petalonema velutinum* (Rab.) Mig.]. (No. 2, 3).— Trichomes épais de 10 μ en moyenne, formés d'articles subsphériques ; gaines jaunes, très lamelleuses, à lamelles souvent divergentes, disposées en entonnoirs ; ramification simple et gémée (fig. 5) ; peu abondant.— Cette espèce vit sur la terre humide et parfois au voisinage des eaux thermales où on l'a signalée en France, en Italie et en Allemagne.

Cylindrospermum stagnale (Kütz.) Born. et Flah. (No. 4).— Diffère du type par les articles des trichomes qui sont subcarrés ou à peine plus longs que larges ; trichomes épais de 3 μ en moyenne ; spores cylindriques, à bouts arrondis, à épispore brune, mesurant 12-16 \times 35-40 μ (fig. 4) ; assez abondant.— Espèce cosmopolite dans les eaux douces ; dans les eaux thermales n'avait été jusqu'ici signalée qu'en Amérique du Nord (Yellowstone) par COPELAND.

EN RESUME, la population algale des sources thermales de Kallirrhœ, telle que la font connaître nos récoltes (et abstraction faite de quelques rares Diatomées) se compose de 17 espèces, qui toutes appartiennent aux Cyanophycées.

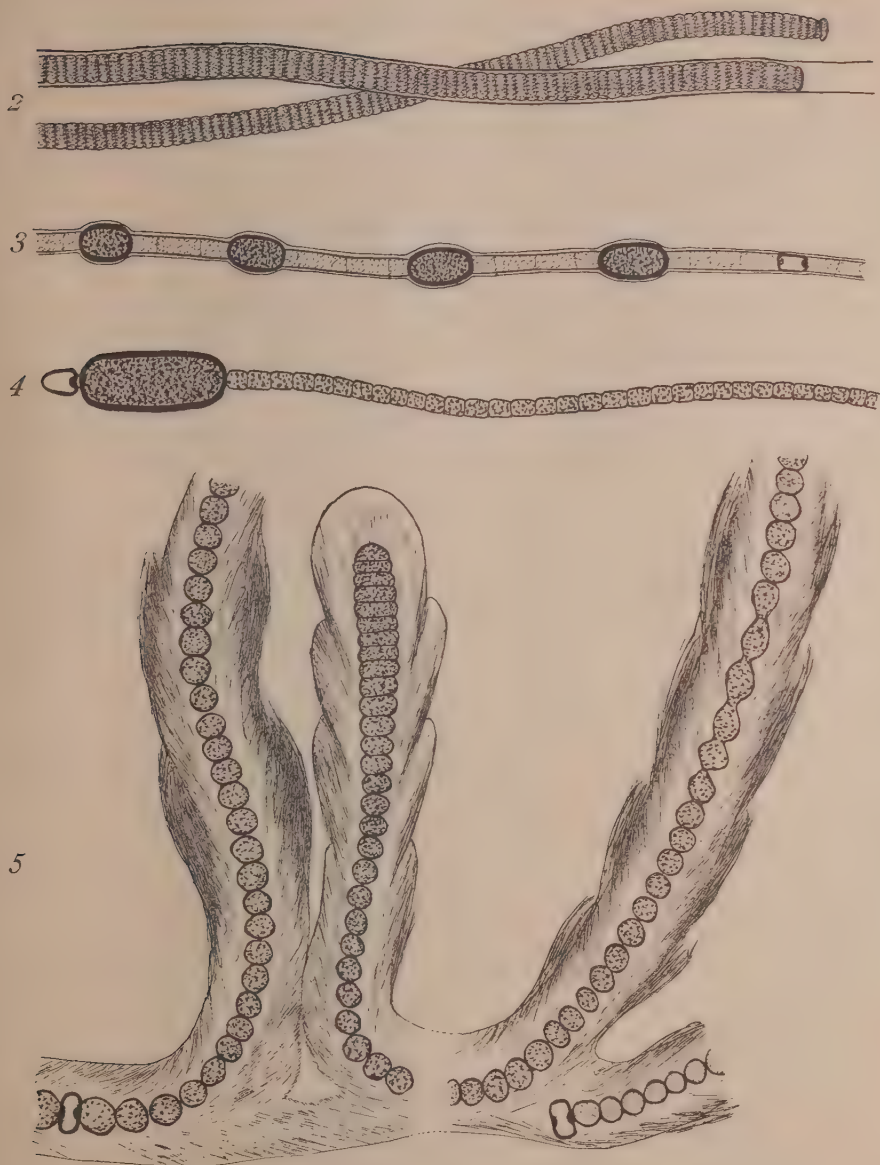


Fig. 2. *Phormidium lucidum* Kütz. $\times 500$.

Fig. 3. *Hapalosiphon laminosus* Hansg. $\times 500$.

Fig. 4. *Cylindrospermum stagnale* (Kütz.) Born. et Flah. $\times 500$.

Fig. 5. *Scytonema velutinum* (Kütz.) Rab. $\times 500$.

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ON THE VEGETATIVE REPRODUCTION OF SOME ORIENTAL GEOPHYTES

By M. ZOHARY

(With 9 figures in the text)

(1) *COLCHICUM STEVENI* KUNTH.

Among the three species of the genus *Colchicum* met with in Palestine *C. Steveni* (Figs. 1—4.) is of special interest because of its mode of vegetative reproduction.

At the base of the flowering stem one may observe in autumn a very short scarious lower leaf which decays soon. The second scarious leaf forms a sheath which envelopes the flowering shoot and decomposes after the rainy season. The sheath of the first green leaf turns into a brown leathery tunic. Above this leaf the other green-sheathless leaves are inserted, and at the top of the stem—the short pedicelled flowers. Somewhat extra-axillary to the first green leaf the renovation bud is inserted. The internode between this leaf and the next upper one is elongated and the lower part of this internode develops into a corm. Opposite the renovation bud (at an angle of ca. 160^0) a second non-axillary bud is found, which develops during the vegetation period into a bulbil.

The interesting point about *C. Steveni* is that the second non-axillary bud is a propagation bud and not a reserve bud. This bud grows to a 4.5 mm. long bulbil, which is connected with the corm until the latter is completely shrunk and exhausted. At the end of the vegetation period, when the corm is almost entirely shrunk, this bulbil disjoins and remains between the corm and the tunic. In the next year the new corm produces likewise a bulbil which also remains between the tunic and the shrunk corm. In this way a number of bulbils accumulates between the tunics of the corm of each adult plant, since the tunics do not decompose easily. The bulbils do not germinate until they are set free from the tunics.

C. Steveni occurs frequently in groups, each flowering plant being surrounded by a number of offsprings of different ages.

Another peculiarity of *C. Steveni* is that non-flowering individuals develop every year on the top of the corm a cluster of 2-8 bulbils

which are set free after the corm is sucked out and dried. These "terminal" bulbils are more or less equal in form and size to those produced by adult plants mentioned above. They occur already on corms of plantules being in the first year of growth and appear every year until the plants enter their flowering age. Only rarely did I notice production of "terminal" cluster bulbils in flowering specimens also and production of single "dorsal" bulbils on non-flowering plants.

The vegetative stage of *C. Steveni* may last 5-8 years and during this period cluster bulbils are produced. It is obvious that this copious production of bulbils is to a certain extent responsible for the delay in sexual reproduction. Among the rich material observed I did not find plantules which grew from seeds, though seeds are abundantly produced.

In the life history of *C. Steveni* three main stages are thus to be distinguished :

(1) Resting bulbils hidden among the tunics of the main corm. Frequently 3-8 bulbils are to be found on a single adult corm, each belonging to a different generation, the outermost being the oldest one.

(2) Vegetatively growing plantules rising mostly from bulbils, both "terminal and "dorsal".

(3) Flowering plants, the corm of which produces generally "dorsal" bulbils.

To reach the flowering stage a bulbil requires a period of 10-15 years.

On corms from which the flowering shoot is removed the dorsal bulbil develops into a secondary shoot on account of the foods stored in the main corm, but under normal conditions the bulbil does not germinate when adherent to the corm¹.

¹ A particular characteristic of the *C. Steveni* should here be mentioned. In addition to its ordinary roots, it produces—especially when the corm is situated more superficially than usual—a thick root resembling in form and direction of growth the contractile roots observed in various geophytes. I have not, however, been able to determine whether this root, as elsewhere, serves to regulate the depth of the corm within the ground.

(2) *GAGEA DUBIA* TERRAC.

As in *Gagea arvensis* I found in this species three kinds of specimens: (a) flowering plants with no propagation bulbils, (b) flowering plants with numerous bulbils scattered in the axils of the upper leaves, (c) non-flowering plants producing instead of flowering shoots headlike clusters of bulbils, which disjoin easily from the axis at the end of vegetation period. These three kinds of specimens we observed in a field near Jerusalem in a more or less equal profusion.

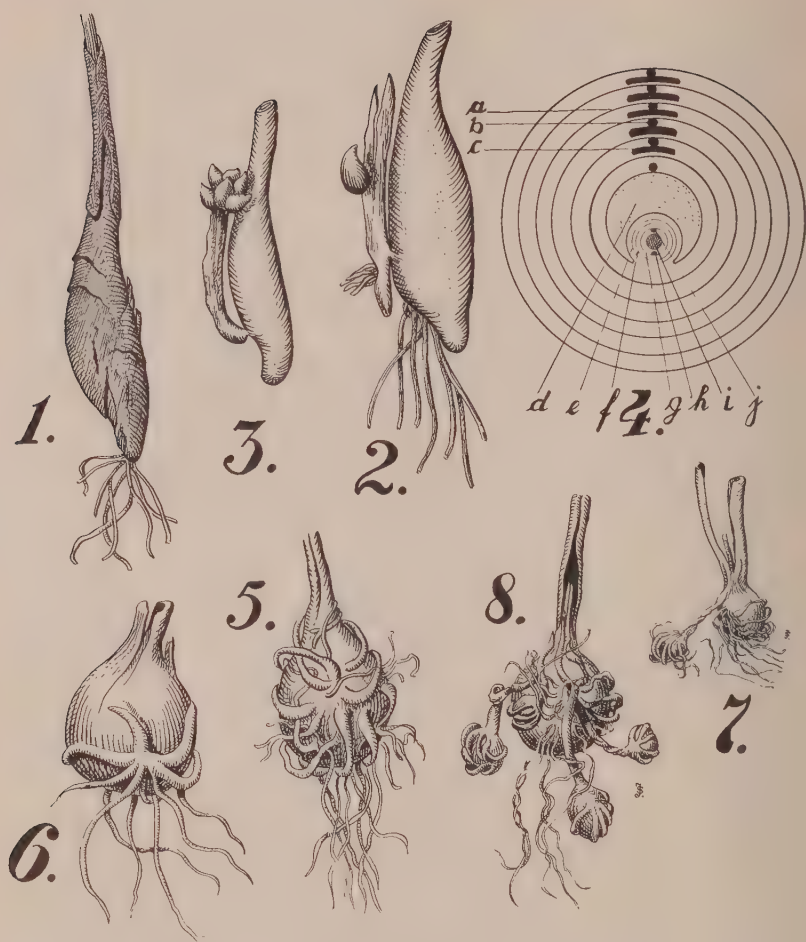
(3) *GAGEA DAMASCENA* Boiss.

Here we noticed only two kinds of specimens: (a) flowering plants without bulbils, (b) plants producing only headlike bulbil clusters. Although a species of a monobulbous group *G. damascena* often develops 2 bulbs each within the sheath of a basal leaf. But there are also intermediate plants with 2 basal leaves of which only one bears a bulb.

(4) *GAGEA RETICULATA* (PALL.) SCHULT.

This species merits special interest because of its mode of vegetative reproduction. Belonging to the subgenus *Hornungia* this species should normally produce a single bulb at the sheathing part of its lower basal leaf. But in the majority of cases observed we found in this species, besides the first green leaf bearing the main bulb, $1 - \infty$ accessory leaves, each bearing a small bulb. These leaves are not attached to the axis, as usual, by their basal sheathing part, but by a higher part of the leaf lamina. The lower part of the lamina, together with its sheathing base, grows horizontally or downward to a spur shaped body (Figs. 7,8). The subterranean parts of the laminae which here serve as stalks for the propagation bulbils differ in form and consistency from the other part of the lamina. At the end of the vegetation period this part of the lamina becomes brittle so that the bulbils disjoin easily from the mother plant. These propagation bulbils (sometimes 6-10 in number) are to be found also on specimens where the accessory leaves are reduced to short filiform laminae which remain subterranean (Fig. 8).

We observed the development of the accessory bulbils in various stages of the plant and never found accessory leaves destitute of bul-



Figs. 1—8. Propagation bulbils of *Colchicum* and *Gagea*.

Fig. 1. *Colchicum Steveni* (external view of the corm). Fig. 2. Corm of a flowering specimen of *C. Steveni*, outer tunics removed, showing the "dorsal" propagation bulbil attached to the shrunk remnant of the corm of the previous year. Fig. 3. Corm of a non-flowering specimen, outer tunics removed, showing the "terminal" cluster of bulbils. Fig. 4. Schematic cross-section of an adult corm showing *a* the dry tunics; *b* the propagation bulbils; *c* the shrunk remnants of the corms; *d* the corm formed in the previous year, in the furrow of which the flowering shoot of this year is situated; *e* lowest short scarious leaf; *f* the scarious long sheathing leaf; *g* the first green

bils, so that this characteristic may be considered a very constant one for *G. reticulata*.

On non-flowering plants the production of bulbils takes place in the same way but the laminae of the leaves are rudimentary generally. The bulbils are able to develop into separate plants and in their first year and to produce accessory bulbils in the same way as adult plants.

The accessory bulbils of *G. reticulata* produce in the first year a bunch of thick fibrous roots which differ markedly from the absorbing roots by their size and direction of growth. As soon as they appear they curve and bend, surrounding the bulbil in various directions and enveloping the bulbil at last with a dense wire-like net. These roots may be seen in adult bulbs of this species also but not always. On the contrary, these roots are a constant feature of *G. rigida* Boiss. (Figs. 5, 6). Being lignified and persisting from year to year on the remainder of the tunics, they increase the volume of the bulbs as a whole considerably. It is difficult to state what function these roots serve in the life history of the plant, but judging by their position and their appearance they may be useful in protecting the bulb against external unfavourable climatic conditions.¹

(5) *GAGEA CIRCINATA* (L.) PASCH.

In this species we observed production of bulbils in head-like clusters only in specimens destitute of flowering stems, both young and adult. One never finds a non-flowering specimen, whatever its age, without propagation bulbils. Apart from this, we occasionally observed development of accessory bulbil-bearing leaves.

¹ In fact most of species of *Gagea* with protecting roots are limited to arid and semi-arid countries where during the dry period a comparatively high temperature prevails in the soil.

stem leaf sheathing at base; *h* the renovation bud; *i* stem; *j* propagation bud developing into a bulbil. Fig. 5. Bulb of *Gagea rigida* showing the two kinds of roots and their position. Fig. 6. Bulb of the same species, outer tunics removed. Fig. 7. Bulb of *G. reticulata*, showing the propagation bulbil borne in the free sheathing part of an accessory leaf. Fig. 8. Bulb of the same species showing propagation bulbils borne in the free sheathing parts of accessory rudimentary leaves.

It should be noticed that *G. reticulata*, *G. rigida* and *G. circinata*, which are very closely related to each other, are very easily distinguishable from one another in vegetative reproduction. Of these 3 species *G. reticulata* constantly bears bulbils on the free basal parts of accessory leaves, *G. circinata* constantly produces head-like clusters of bulbils in the axil of the main bulb, and *G. rigida* does not produce propagation bulbils at all (Fig. 5).

(6) *ALLIUM AMPELOPRASUM* L.

The bulb of this plant produces, as is well known, a great number of collateral bulbils in the axils of the leaf base (Fig. 9). These bulbils are more numerous in the axils of the outer leaves than in those of the inner. Since these bulbils are attached to the axis by means of capillary stalks and the outer tunics of the bulb decompose during the flowering season the bulbils are easily set free. In the first year of their vegetative growth they already begin to produce accessory bulbils, but at this time the propagation bulbils are generally limited to the axils of the first leaf.

In addition to these bulbils borne on capillary stalks, we observed in many cases — especially where the bulbs were too superficially placed — the production of another kind of bulbils borne on thicker

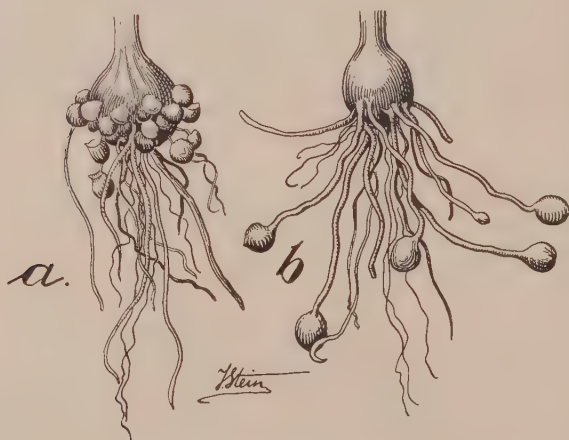


Fig. 9. Propagation bulbils in *Allium Ampeloprasum*. *a* bulb with collateral short-stalked bulbils; *b* bulb with "stolon bulbils".

stolonlike 3-8 cm. long stalks which grow vertically into the soil (Fig. 9) and resemble the "stolons" met with in various species of *Tulipa*. These bulbils are of the same origin as the simple propagation bulbils. In their early stage they are somewhat laterally compressed and borne on a thin stalk, but afterwards the basal parts of their first leaf elongates into a root-like body, penetrating the tunics and growing downwards. Reaching its final length the top of the stalk gradually begins to thicken owing to the growth of the other leaves and the bud hidden in this stalk-like lowest bulbil leaf. At the end of the vegetation period this "stolon bulbils" reach its final size, considerably larger than the usual short, thin stalked ones.

Specimens which develop such "stolon bulbils" are generally destitute of other propagation bulbils.

The development of such "stolon bulbils", together with the production of contractile roots, seems to be useful in regulating the normal depth conditions of the bulb.

A MONOGRAPHIC STUDY ON THE GENUS
BELLEVALIA LAPEYR.
(CARYOLOGY, TAXONOMY, GEOGRAPHY)

By NAOMI FEINBRUN

(With Plate IV and 17 figures in the text)

During the last ten years various investigators have tried to approach the knowledge of the actual evolutionary processes involved in the development of a certain systematical group of plants (family, tribe, genus) and of their relative importance. The aims and the methods of such research were best expounded by BABCOCK (1934) in his paper summing up work on the genus *Crepis*.

"... The relative importance of these or other casual agencies in organic evolution remains for the future to disclose. Meanwhile it has been possible to learn something about the various types of genetic change which have played a rôle in the evolution of groups of organisms by the study of the organisms themselves. The method used includes four steps: (1) determination of relationships within and between natural groups of species by means of such criteria as comparative morphology, geographic distribution, chromosome number and morphology, and cytogenetics; (2) comparison of the evidence on classification so derived; (3) the synthetic treatment of this evidence in respect to the phyletic relations of the species under consideration; (4) derivation of conclusions regarding the nature of the genetic changes involved in the evolution of a given group of species."

It will be doubtless very useful to extend investigations over many genera.¹ The present study is a contribution to these problems. It is to be regarded as preliminary.

The paper contains a caryological and a taxonomic-geographical part followed by considerations on the phylogeny of the genus.

¹ It seems to us that investigations within genera can be for the present much more effective than those of families or tribes, because families (or tribes) can generally be studied only fragmentarily and because the elucidation of phylogenetic relations between genera of any family or tribe is necessarily much more difficult than those of the species of a genus.

I take pleasure in thanking Dr A. Eig of the Department of Botany of the Hebrew University for his continuous interest in this study, as well as for his valuable advice, particularly in the taxonomic-geographical part.

To Dr L. Doljansky of the Cancer Research Laboratories of the Hebrew University I am indebted for his kind assistance during the preparation of the caryological part and for advice in taking the microphotographs.

I take this opportunity to express my best thanks to Prof. A. Guillermond of Sorbonne (Paris) for kind reception to his Laboratory during my stay in Paris in connection with the preparation of this study. Thanks to his assistance I was enabled to add considerably to my cytological experience.

I am also grateful to Dr A. Eichhorn (Paris) for his kind help and especially for useful suggestions regarding cytological technique.

(I) CARYOLOGICAL PART

(a) *Material and Methods*

Material for the study consisted of root tips from bulbs of 9 species of *Bellevalia*, chiefly from the bulb collection of the Botanical Garden of the Hebrew University¹. The root tips were obtained in glass cultures during or at the end of the resting period of the bulbs. In some cases the formation of roots was stimulated by low temperature. The determination of the species was in all cases verified during the flowering.

The roots were fixed in the solution of LEWITSKY (chromic acid 1% + formalin 10% mixed before use in proportion of 5:5; in several cases the proportion was changed as follows: 3:7, 4:6, 6:4, 7:3; duration of fixation 6 to 24 hours). The solution of NAWASHIN (10 p. of chromic acid 1% + 1 p. acetic acid + 4 p. formalin 40%) and that of HELLY (1 p. of formalin 40% mixed before use with 9 p. of a solution of 5 g. bichromate of K + 5 g. corrosive sublimate + 100 cc. dist. water) were also tried, but proved in our case to be inferior in effect to the solution of LEWITSKY (Pl. IV, f. 16). The qualities of the last solution are homogeneous fixation, absence of a halo around

¹ Bulbs of two species were kindly sent to us by Mr M. ZULFICAR BEY, Director of the Fouad I Agricultural Museum, Giza, and by Mr. SHABBETAI Chief Botanist of the Botanical and Plant Breeding Section, Giza (Egypt). I take this opportunity of thanking them for their kind assistance.

the nucleolus, clearness of the chromosome morphology (primary and secondary constrictions, etc.). The solution has also the great advantage of being cheap and easily prepared and is therefore greatly to be recommended.

Paraffin sections were cut longitudinally 10-15 μ thick in the 2x species and 17-22 μ in the polyploid species. The preparations were stained with HEIDENHAIN'S iron-haematoxylin.

Mitotic anaphase figures seen from the side were chosen as the most advantageous for study of both number and morphology of chromosomes (already noted by DARLINGTON, 1926).

Measurements of chromosome lengths were made by means of the Ramsden-screw-ocular-micrometer.

(b) *The cycle of the chromosome*

It was not the purpose of this study to deal specially with the problems concerning the structure of the chromosome. The following are some observations arrived at on our material without the use of special methods of preparation.

Although very properly fixed without any halo around the nucleolus, the resting nucleus appears rather granular; no spiral thread could be revealed in our preparations at this stage (Pl. IV. f. 1).

At the prophase, on the contrary, the structure of the chromosomes is quite distinct. Relic spirals are prominent. Moreover, in the split chromosomes two spiralized chromonemata can be distinguished (Pl. IV. fs. 2, 3). At the metacinese and the metaphase the increasing chromaticity of the chromosomes obscures their internal structure. At the metaphase the spiral character of the chromatids can, however, be revealed. The split between the chromatids is distinctly seen (Pl. IV. f. 5). The centric (primary) constriction can also be shown and its position makes it possible to identify, at this stage, the different types of chromosomes (see farther) (Pl. IV. f. 6).

Satellites could not be revealed before the metaphase (Pl. IV. f. 7) and not later than the early telophase (Pl. IV. f. 13).

The uneven contours of the anaphase chromosomes suggest that they are spiral in structure. The question whether the chromosomes are double (KOSCHY 1937, NAITHANI 1937) or simple (DARLINGTON 1937) cannot be discussed on the basis of our material at this stage.

At the telophase a coiled chromonema is clearly seen (Pl. IV. f. 14).

(c) *The number of nucleoli*

With reference to the number of nucleoli, numerous plants have after TISCHLER (1934), one nucleolus per nucleus, others 2-3, and only in certain cases is their number relatively high. TISCHLER remarks that the primary number of nucleoli appearing in the young nuclei is to be distinguished from the secondary one derived later.

In comparison with these data the number of nucleoli in the species of *Bellevalia* is rather high. We found in the young nuclei of the majority of the investigated species four nucleoli, in one species even six. This number often diminishes later by fusion but rarely decreases to one. Very often the primary number increases, probably by fragmentation, and reaches 7-8 or even 12 (see TABLE I). Nucleoli in young nuclei and their symmetrical arrangement are shown in Pl. IV. f. 15.

We will later discuss the relation between the number of nucleoli and satellited chromosomes. Here it may be emphasized that in contrast to the evidences stated by DE MOL (1926) for *Hyacinthus orientalis*, in *Bellevalia* there is no direct proportion between the number of the nucleoli and polyploidy.

(d) *The number of chromosomes in the species of Bellevalia*

TISCHLER (1931) records in his last list of chromosome numbers 8 species of *Bellevalia*¹. The number of all these species is $2n=8$. No ulterior data on the chromosome numbers of the genus were published.

Our caryological studies treat 9 species of *Bellevalia* of which one has already been studied before. In 5 of these species we found 8 somatic chromosomes; in 3 others $2n=16$, and at last in one species $2n=24$ were found.

Evidently the basic number of the genus is 4; the somatic chromosome numbers present a series of $2x$, $4x$, $6x$. This fact was not known previously for *Bellevalia*.

TABLE I sums up all data on the numbers of chromosomes and nucleoli for this genus.

¹ As a matter of fact 11 species are recorded, but 3 of them, *B. forniculata*, *B. acutifolia*, *B. azurea*, do not belong to the genus *Bellevalia* as is shown in the taxonomic part.

TABLE 1.

Name of the species	Number of nucleoli		2n	Satellited chromosomes	Research by
	primary	secondary			
SECT. <i>NUTANS</i>					
<i>B. trifoliata</i> (Ten.) Kth.	4	7-8	8	P S	DE MOL, 1926; FEINBRUN, 1938
<i>B. macrobotrys</i> Boiss.	not reported		8	not reported	DELAUNAY, 1926 (sub <i>B. zygomorpha</i> Wor.)
<i>B. Fominii</i> Wor.	"	"	8	" "	DELAUNAY, 1926
<i>B. Webbiana</i> Parl.	"	"	8	" "	DE MOL, 1921
<i>B. Warburgii</i> sp. n.	4	7	16	P S	FEINBRUN 1938
<i>B. alexandrina</i> sp. n.	6	12	24	P S	" "
SECT. <i>CONICA</i>					
<i>B. ciliata</i> (Cyr.) Nees	not reported		8	not reported	DELAUNAY 1926; DE MOL (in letter.)
<i>B. longipes</i> Post	4	6	8	none	FEINBRUN 1938
<i>B. Wilhelmii</i> (Stev.) Wor.	not reported		8	none	DELAUNAY 1922; LEWITSKY
<i>B. speciosa</i> Wor.	"	"	8	not reported	DELAUNAY 1926 et TRON 1930
<i>B. stepporum</i> sp. n.	3-4	—	16	S	FEINBRUN 1938
<i>B. palmirensis</i> sp. n.	4	5	16	R S	" "
SECT. <i>PATENS</i>					
<i>B. romana</i> (L.) Reich.	not reported		8	P S	DELAUNAY 1926; DE MOL 1921; DARLINGTON 1926
<i>B. flexuosa</i> Boiss.	4	5	8	P S	FEINBRUN 1938
<i>B. sessiliflora</i> (Viv.) Kth.	—	—	8	P S	" "
<i>B. desertorum</i> Eig et Feinbr.	4	5	8	P S	" "

(e) *The morphology of chromosomes in the genus Bellevaia*

The morphology of the chromosomes of the genus *Bellevaia* was studied by DELAUNAY (1922) and by DARLINGTON (1926). The latter did not mention the paper of DELAUNAY which had been published in Russian. The names of the species studied can be seen in TABLE I. The results of their investigations on the morphology of chromosomes of *Bellevaia* were chiefly identical. In the haploid chromosome set 4 types of chromosomes are represented, every type characterized by its form and size. DELAUNAY marked them by characters PQRS and DARLINGTON by ABCD. We have adopted the designation of DELAUNAY.

All chromosome types are eubrachial (LEWITSKY 1931a), 3 of them heterobrachial and 1 isobrachial. We give here a short description of each type (figs. 1—9).

Chromosome P: Isobrachial; DARLINGTON designated (for *B. romana*) a satellite at the distal end of the shorter arm.

Chromosome Q: Heterobrachial; the longer arm longer than any arm of P; the shorter arm several times shorter than the longer one.

Chromosome R: Heterobrachial; the longer arm shorter than the longer one of Q; the shorter arm is less than half as long as the longer, and is generally somewhat longer than the shorter arm of Q.

Chromosome S: Heterobrachial; longer arm still shorter; the shorter one about half as long as the longer. In several species the longer arm bears a satellite¹.

This scheme is generally true for all the species studied by us. We could however distinguish differences in absolute and relative length of arms in different species. In the majority of species satellites are present on chromosomes P and S. Satellited chromosomes of the species are designated in TABLE I and in figs. 1—17.

(f) *The homology of the genomes of the polyploid Bellevaia species*

With regard to the polyploid species the question arises whether they are auto- or allopolyploids, i.e. if their genomes are homologous or not.

¹ In the description of this chromosome and in Fig. 2 DARLINGTON (1926, p. 243) erroneously represents a satellite on the shorter arm, but in the drawing (Pl. XVII, fig. 18-19) the satellites are represented correctly.

To solve this problem by means of mitotic chromosomes different methods may be employed. The first would be the comparison of the size of corresponding chromosomes of each type, their absolute length and the relative length of their arms.

In our material differences in length of arms of chromosomes of the same type were obvious in several cases. This may be seen for instance for chromosomes P of *B. Warburgii* (figs. 2, 10). But the differences could not be expressed numerically, because it would require very numerous measurements owing to the high variability of the length of chromosomes not only in different roots, but even in the same section. An additional source of error is the contraction of the chromosomes during the anaphase.

Another method for this purpose is to use the satellites as distinguishing morphological characteristic. For instance, the presence of four satellited P chromosomes among the eight of this type in a tetraploid species, is evidence of its genomes being non-homologous. Unfortunately, establishing the number of the satellited chromosomes involves difficulties. As already noted by DARLINGTON (1926) in regard to *Bellevia romana* ($2n=8$) it is not always possible to see in the anaphase all four satellites together "owing either to the staining being

EXPLANATION OF PLATE IV.

Root tip division.

- | | | |
|------------|-------------------------|---|
| Fig. 1. | <i>B. desertorum</i> . | Resting nucleus; 5 nucleoli are seen. |
| Fig. 2, 3. | " | Prophase. The arrow shows the spiralised chromonemata. |
| Fig. 4. | " | Late prophase (metacinese). |
| Fig. 5. | " | Metaphase; note spiralised chromatids. |
| Fig. 6. | " | Metaphase; note centric constriction. |
| Fig. 7. | <i>B. trifoliata</i> . | Metaphase; note the still undivided satellite. |
| Fig. 8. | <i>B. desertorum</i> . | Anaphase. |
| Fig. 9. | <i>B. longipes</i> . | Anaphase. |
| Fig. 10. | <i>B. stepporum</i> . | Anaphase. |
| Fig. 11. | <i>B. palmyrensis</i> . | Anaphase. |
| Fig. 12. | <i>B. alexandrina</i> . | Anaphase. |
| Fig. 13. | <i>B. desertorum</i> . | Early telophase; note satellites. |
| Fig. 14. | " | Late telophase; note spiralised chromonemata. |
| Fig. 15. | " | Young nuclei showing the symmetrical arrangement of nucleoli. |
| Fig. 16. | " | Unfit fixation by NAWASHIN's solution. |
- (Microphotographs taken by Leica camera. Enlargement ca. 1600).



too faint, or to its lying directly over the main limb of the chromosome or perhaps even to their being fused" (p. 244). It is evident that in the polyploids this difficulty is still greater.

We, therefore, arrived at the number of satellited chromosomes of the polyploids indirectly by deducing it from the number of their nucleoli.

The connection between the satellited chromosomes and the nucleoli is known since S. NAWASHIN's (1914-1927) investigation on *Galtonia candicans*. The problem was later treated by different authors. Especially remarkable are the investigations of HEITZ (1931) who demonstrated that the nucleoli appear at the end of the telophase in number and position corresponding to the number and position of the satellited chromosomes. GEITLER (1932) defined the relations between the nucleoli and the satellited chromosomes as follows: "Immer wenn SAT-Chromosomen vorhanden sind, muessen an ihnen die Nukleolen entstehen. Die SAT-Chromosomen wirken begrenzend auf die Zahl, Lage und Groesse der Nukleolen. Fehlen die SAT-Chromosomen, so koennen sich die Nukleolen trotzdem bilden". McCLINTOCK (1934) succeeded in revealing the physiological character of the relation between the nucleoli and the satellited chromosomes. She demonstrated on *Zea Mays* that the accumulation of the nucleolus at the telophase depends on a definite locus situated next to the filament bearing the satellite. The secondary constriction is, accordingly, named by DARLINGTON (1937) nucleolar constriction. The localization of the nucleolar organizing body next to the secondary constriction is confirmed by FERNANDES (1936) on *Narcissus*.

The dependence of the nucleoli on the satellited chromosomes can thus be regarded as proved.

In the diploid species of *Bellevalia* (*B. trifoliata*, *B. flexuosa*, *B. desertorum*) we could really ascertain that the number of nucleoli (4) corresponds to the number of their satellited chromosomes. We concluded, therefore, that in the polyploids the number of nucleoli can be used to establish the number of the satellited chromosomes. Towards this end we proceeded in the following manner. First we established the type of the chromosomes bearing satellites. This was done without difficulty by observation of several preparations. For instance, in *B. Warburgii* (4x) satellites could be seen distinctly on chromosomes of the types P and S. As the number of nucleoli of this species is 4, we inferred that only two chromosomes of each type, belonging to two homologous genomes, are satellited, while the other two of each

type (of the other two genomes) are without satellites. Consequently the four genomes of this species are not homologous and the species may be regarded as allopolyploid.

In the same way it was possible to establish that the other three polyploid species have non-homologous genomes, and are allopolyploids as well.

(g) *Description of the idiograms* (figs. 1—17).

In the following the idiograms of the nine investigated *Bellevia* species are given.

B. trifoliata (fig. 1) $2n=8$ (2Q 2P' 2R 2S').¹

Satellited chromosomes P and S. The variability of the length of chromosomes very considerable.

B. Warburgii (fig. 2, 10).

$2n=16$ (2Q₁ 2Q₂ 2P'₁ 2P'₂ 2R₁ 2R₂ 2S'₁ 2S'₂).²

Satellites on two of each of the types P and S. Distinct differences in length of the arms of Q and R chromosomes of different genomes permit to distinguish Q₁ and Q₂, and R₁ and R₂.

¹ Apostrophe designates satellite.

² Evidently the placement of this or other chromosome into genom 1 or 2 is arbitrary. It is important only to distinguish two forms among the chromosomes of the same type.

LEGEND TO FIGS. 1—17.

























Figs. 1—9. Diagrams of chromosome complements of the species investigated.

























- | | |
|--------------------------|---------------------------|
| 1. <i>B. trifoliata</i> | 6. <i>B. palmyrensis</i> |
| 2. <i>B. Warburgii</i> | 7. <i>B. flexuosa</i> |
| 3. <i>B. alexandrina</i> | 8. <i>B. desertorum</i> |
| 4. <i>B. longipes</i> | 9. <i>B. sessiliflora</i> |
| 5. <i>B. stepporum</i> | |

























Figs. 11—17. Drawings of somatic anaphases (chromosome drawn separately).


















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|---|--|
| 10. <i>B. Warburgii</i> | 14. <i>B. palmyrensis</i> |
| 11. <i>B. alexandrina</i>
(one chromosome is missing). | 15. <i>B. flexuosa</i>
(one Q chromosome is cut). |
| 12. <i>B. longipes</i> | 16. <i>B. desertorum</i> |
| 13. <i>B. stepporum</i> | 17. <i>B. sessiliflora</i> |

























The drawings were made by direct projection using the Panphote (Reichert), a Reichert apochromatic objective 96×(1,33) and a 10×eyepiece. Enlargement 2500 reduced to ½. The characters designate the types of chromosomes.





















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


















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

















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
















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













5.    
   
   
   
   
   

10.    
   
   
   
   

11.    
   
   
   
   

12.    
   
   
   
   

14.    
   
   
   
   

16.    
   
   
   
   

B. alexandrina (figs. 3, 11; Pl. IV. f. 12).

$2n=24$ (4 or $2Q_1$ 2 or 4 Q_2 $2P'_1$ $4P_2$ $4R_1$ $2R_2$ $4S'_1$ $2S_2$).

Nucleoli 6. Satellites on four chromosomes of the type S and on two of the type P. There are differences in length of the short arm of Q, in the relative length of the arms of P, in length of the arms of S (S_1-S_2).

B. longipes (figs. 4, 12; Pl. IV. f. 9).

$2n=8$ ($2Q$ $2P$ $2R$ $2S$).

Satellites absent. Chromosome R and S longer than in other species, especially the former.

B. stepporum (figs. 5, 13; Pl. IV. f. 10).

$2n=16$ ($2Q_1$ $2Q_2$ $2P_1$ $2P_2$ $2R_1$ $2R_2$ $2S'_1$ $2S'_2$).

Nucleoli 4. Satellites only on S, which means that all four S chromosomes are satellited. On the contrary, distinct differences in size of the chromosomes indicate the inequality of the genomes. Q_1-Q_2 can be distinguished by differences in length of the short arm; P_1-P_2 in the whole length of the arms; R_1-R_2 in absolute and relative length of arms; S_1-S_2 in the whole length of the chromosomes.

B. palmyrensis (figs. 6, 14; Pl. IV. f. 11).

$2n=16$ ($2Q_1$ $2Q_2$ $2P_1$ $2P_2$ $2R_1$ $2R'_2$ $2S'_1$ $2S_2$).

Nucleoli 4. Satellited chromosomes S and R. According to the number of nucleoli satellited chromosomes are $2S_1$ and $2R_1$. Besides, there are differences in the length of the short arm of Q (Q_1-Q_2), in the length of the arms of P (P_1-P_2) and of R (R_1-R_2).

B. flexuosa (figs. 7, 15), *B. sessiliflora* (figs. 9, 17), *B. desertorum* (figs. 8, 16; Pl. IV. f. 8). $2n=8$ ($2Q$ $2P'$ $2R$ $2S'$).

Satellited chromosomes P and S.

SUMMARY OF THE CARYOLOGICAL PART

(1) Species of *Bellevaia* are convenient material for study of both morphology of their chromosomes and the cycle of chromosome during the mitosis.

(2) The number of nucleoli of the species of *Bellevaia* is high. The primary number (that of the young nucleoli) is 4-6, the secondary reaches 7-12.

(3) Numbers of chromosomes are known so far for 16 species of *Bellevaia*; for 8 species the numbers are recorded here for the first time. The basic number (x) is 4. Polyploidy in four species is demonstrated. In 3 of them $2n=16$ and in one $2n=24$.

(4) Four morphologically distinct types of chromosomes described previously for the genus *Bellevaia* are peculiar to all investigated species. In several species satellited chromosomes are present.

(5) Idiograms of the 9 investigated species are described.

(6) By means of differences in size of chromosomes of the same type and by means of the presence or absence of satellites on the same chromosome type, inferred chiefly from the number of nucleoli, it has been demonstrated that the genomes of the polyploids are not homologous. It is concluded that the polyploids are allopolyploids.

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STUDIES IN PALESTINIAN LENTILS II. ¹THE VARIETIES OF THE CULTIVATED COMMON LENTIL
IN PALESTINE

By D. V. ZAITSCHEK

CLASSIFICATION OF *Lens esculenta* MOENCH

Until the appearance of BARULINA's (1930) comprehensive monograph the classification of the varieties of the lentil has been very incomplete. ALEFELD (1866) was the first to distinguish 8 varieties², which he divided into two groups. These groups vary in height of plant, colour and pubescence of leaves and in vegetation period. He bases this division on the colour of the seedlings, the shape of the leaflets, the colour of the corolla and finally on the colour, the pattern and the weight of the seeds. KOERNICKE (1873) added to this system one more variety and one subvariety, but does not mention another ALEFELD variety. HARZ (1885) describes 5 forms and designates one ALEFELD variety as an independent species. Subsequent authors have accepted ALEFELD's classification, modifying it slightly, such as ASCHERSON und GRAEBNER (1906-10), who distinguished 7 varieties divided into two larger groups.

It was not until BARULINA (1930, 1937) that the broad foundation was laid for a classification. She was fortunate in having for study the rich world collections of lentils of the Institute of Applied Botany at Leningrad. This material, from the widely varying geographic regions, betrays the unusual polymorphism of the cultivated lentil and demonstrates at the same time the weak foundation of the system hitherto. BARULINA worked out a general scheme of the hereditary variation of the species *Lens esculenta* Moench., on the basis of exact investigations during a number of years. This scheme contains 40 hereditary varying features, 6 of which refer to the flower, 8 to the pod, 9 to the seed, 12 to vegetative, 4 to biological and one to anatomical characters. The principal of classification by BARULINA is a morphological-geographical one. She distinguishes 2 vast groups—

¹ Part I of this paper is appearing in the Jubilee Volume of Dr. J. L. Magnes, published by the Hebrew University Press (in Hebrew).

² Of this number one variety should be eliminated, as it belongs now to another species (*Lens esculenta himalayensis* Al.=*Lens orientalis* (Boiss.) Hand.-Mazz.).

subspecies — differentiating sharply from one another morphologically: the large-seeded lentil — subspecies *macrosperma* Bar. and the small-seeded lentil — subspecies *microsperma* Bar. and defines their geographical areas precisely. The small-seeded lentil is more polymorphous than the large-seeded one, and may be divided into 6 narrower geographical groups of varieties — proles: *subspontaneae* Bar., *pilosae* Bar., *aethiopicae* Bar., *asiaticae* Bar., *intermediae* Bar., and *europaeae* Bar. Each of these proles is distinguished by a whole complex of morphological characters as well as by geographical isolation. The division into varieties is based on non-geographical and non-fluctuating characters convenient for identification and practically most important, as, for example, the colour and pattern of the seed coat and colour of the cotyledons. (An additional division into races may be made on the basis of fluctuating, chiefly quantitative characters.). This new classification of BARULINA brought to light 59 varieties instead of the 7 or 8 which had been known till then.

INVESTIGATIONS ON PALESTINIAN LENTILS

BARULINA was also the first to include in her classification many samples of Palestinian lentils. These are the most polymorphous group after the lentils of Asia Minor. 15 of her 59 varieties were found in Palestine — chiefly the small-seeded lentil, ssp. *microsperma* (with 13 of 47 varieties) and both of its proles, *asiaticae* (with 9 of 22) and *intermediae* (with 4 of 9) but also the large-seeded lentil, ssp. *macrosperma* (with 2 of 12). The following varieties are indigent to Palestine:

ssp. <i>microsperma</i>	ssp. <i>microsperma</i>	ssp. <i>macrosperma</i> :
proles <i>asiaticae</i> :	proles <i>intermediae</i> :	
var. <i>viridula</i>	var. <i>subviridis</i>	var. <i>rubiginosa</i>
<i>palaestina</i>	<i>subatrovirens</i>	<i>iberica</i>
<i>maculosa</i>	<i>variegata</i>	
<i>persica</i>	<i>subrubiginosa</i>	
<i>nigripunctata</i>		
<i>maculata</i>		
<i>violascens</i>		
<i>punctata</i>		
<i>syriaca</i>		

(The remaining 4 proles of the ssp. *microsperma* with their 15 varieties have not been found in Palestine.)

The classification of BARULINA has proved very useful for my investigations being founded on the most recent aspects of taxonomy and differing from the former systems by its sound genetical and phytogeographical basis.

The material at my disposal comes from all administrative districts and subdistricts alike of Palestine and Transjordan and represents at the same time the phytogeographic territories and the natural regions of cultivation of the country. My investigations resulted in increasing knowledge of the cultivated common lentil varieties of Palestine. Besides the 15 varieties known till now 9 more varieties have been identified which were known only in other countries; 18 additional varieties could be described as new. The number of the Palestinian varieties is thus increased to 42 and the total number of the known varieties increases to 77, emphasizing the polymorphism of the Palestinian lentil.

The cause of the great variability of the Palestinian group may be sought in its nearness to the centre of origin of lentil cultivation, which must have been situated in Southwest Asia. Palestine, Syria and Asia Minor form a region of mutual overlapping of the distribution areas of both subspecies *microsperma* and *macrosperma*. They represent also the area of proles *intermediae* which may be considered as a transition between the two subspecies. This interesting fact helps bring us closer to a better understanding of the great diversity of forms.

In the three groups (1) proles *asiaticae* and (2) proles *intermediae* of the ssp. *microsperma* and (3) ssp. *macrosperma* all the Palestinian varieties may be included, and they are to be found together within the homologous series of characters of these groups. Some characters of higher taxonomical value are common to the Palestinian representatives of all three groups — the usual green colour and medium pubescence of the plant, the non-dehiscent pods of usual green colour and common shape, the number of flowers on peduncle (1-3), and, above all, the white colour of the corolla (standard with blue veins), then the length of calyx teeth (longer or as long as the corolla). The hitherto known Palestinian varieties are restricted to a few types of the characters essential for varieties, viz. colour and pattern of seed coat and colour of cotyledons, and these characters recur homologously

I.

VARIETIES OF *Lens esculenta* MOENCH¹

t e r m e d i a e		m a c r o s p e r m a									
(B)		(II)									
yellowish-pink (2)		greyish-reddish (3)		yellow-green (1)		yellowish-pink (2)		greyish-reddish (3)			
y	o	y	o	y	o	y	o	y	o		
flavoreosa v.n.	rhodosperrma Bar.	subiberica v.n.	subrubiginosa Bar.	nummularia Al.			(sicula Bar.)	iberica Bar.	rubiginosa Bar.		
	variegata Bar.		marmoriata Bar.								
	cypria Bar.		subthesalia v.n.								
judaica v.n.	moabitica v.n.	maculato-rubiginosa v.n.	transjordanica v.n.	atrovirens Bar.							
	gileadensis v.n.		philadelphica v.n.	(Pulmanii Bar.)							

² Or with dark green marble pattern in the group of yellow-green seed coat.

³ This combined type does not occur in Palestine.

in the groups. Of the 8 colour types of seed coat given by BARULINA there are only 3 here: (1) yellow-green — 5 varieties, (2) yellowish-pink — 4, and (3) greyish-reddish — 6. As for the pattern of the seed coat, they belong to only 4 out of 7 types: (a) one-coloured without pattern (or with dark green marble pattern in the group of yellow-green seed coat) — 6, (b) with black marble pattern — 1, (c) with dots — 4, and (d) with spots — 6. According to the colour of the cotyledons they belong to both of the known types: yellow — 6 and orange — 9.

The varieties described in our paper can easily be assigned to the homologous series of the varieties hitherto known. They, too, belong to the 3 groups mentioned above and have the above-mentioned characters of higher taxonomical value in common with the varieties familiar to Palestine. The differentiating characters as far as basic colour of seed coat are concerned, are restricted (as with the varieties mentioned for Palestine by BARULINA) to the following 3 colour types: viz. yellow-green, yellowish-pink and greyish-reddish. They merely amplify the picture in connection with the pattern of the seed coat.

Besides the groups designated above by a, b, c, d, we found among our material representatives of the following combined types, new to Palestine: (e) with black or dark purple dots and spots — the combination of c and d, (f) with dark brown marble pattern and black spots — the combination of b and d, and finally one new combined type (g) with marble pattern, dots and spots — one combination of b, c and d. With regard to the pattern of the seed coat, except for the type last mentioned, homologous characters already known in other groups are involved. The attached Table I illustrates the grouping of the Palestinian varieties within the 3 groups: (1) *proles asiaticae*, (2) *proles intermediae*, both of *ssp. microsperma*, and (3) *ssp. macrosperma*. Only the three colour types of seed coat occurring in Palestine were taken into account.

KEY TO THE PALESTINIAN VARIETIES OF *Lens esculenta* MOENCH
(after BARULINA).

- I. Seeds small or medium sized (3-6 mm. in diameter),
more or less bulgy. Pods small (6-15 mm.
long, 3,5-7 mm. width). Flowers small
(5-7 mm. long), of different color
ssp. *microsperma* (Baumg.) Bar.
- A. Seeds 3-5 mm. diameter, flowers and leaflets small
proles *asiaticae* Bar.
 1. Seeds yellow-green. Cotyledons yellow.
 - Seeds without pattern.....var. *viridula* Bar.
 - Seeds with black dots.....var. *palaestina* Bar.
 - Seeds with black spots.....var. *maculosa* Bar.
 2. Seeds yellowish-pink (seed coat almost colour-
less, colour of seeds dependent on colour
of translucent cotyledons).
 - a. Cotyledons yellow.
 - Seeds without pattern.....var. *gilva* Bar.
 - Seeds with black spots, concentrated
chiefly around the hilum...var. *atrogilva* var. nov.
 - Seeds with black (dark purple) dots and
spots.....var. *steppica* var. nov.
 - Seeds with well-marked dark brown marble
pattern and black spots
var. *atromarmorata* var. nov.
 - b. Cotyledons orange.
 - Seeds without pattern.....var. *persica* Bar.
 - Seeds with minute black (dark purple) dots
var. *nigripunctata* Bar.
 - Seeds with black spots, concentrated
chiefly around the hilum.....var. *maculata* Bar.
 - Seeds with black (dark purple) dots and
spots.....var. *iranica* Bar.
 - Seeds with well-marked dark brown marble
pattern and black spots
var. *maculatomarmorata* var. nov.
 - Seeds with marble pattern, dots and spots
var. *tripicta* var. nov.

3. Seeds greyish-reddish (slightly violet).

a. Cotyledons yellow.

Seeds without pattern... var. *flavoviolascens* var. nov.Seeds with black spots, concentrated chiefly around the hilum... var. *atroviolascens* var. nov.

b. Cotyledons orange.

Seeds without pattern... var. *violascens* Bar.Seeds with black (dark purple) dots
var. *punctata* (Al.) Bar.Seeds with black spots, concentrated chiefly around the hilum... var. *syriaca* Bar.Seeds with black (dark purple) dots and spots... var. *arabica* var. nov.Seeds with well-marked dark brown marble pattern and black spots... var. *atrorubiginosa* Bar.Seeds with marble pattern, dots and spots
var. *hierosolymitana* var. nov.B. Seeds 5-6 mm. in diameter, flowers and leaflets medium... proles *intermediae* Bar.

1. Seeds yellow-green. Cotyledons yellow.

Seeds one-coloured or with dark green marble pattern... var. *subnummularia* Bar.Seeds with black (dark purple) dots
var. *subviridis* Bar.Seeds with black (dark green) spots
var. *subatrovirens* Bar.

2. Seeds yellowish-pink.

a. Cotyledons yellow.

Seeds one-coloured... var. *flavorosea* var. nov.Seeds with black spots, concentrated chiefly around the hilum... var. *judaica* var. nov.

b. Cotyledons orange.

Seeds one-coloured... var. *rhodosperma* Bar.Seeds with black marble pattern... var. *variegata* Bar.Seeds with black dots... var. *cypria* Bar.Seeds with black spots, concentrated chiefly around the hilum... var. *moabitica* var. nov.Seeds with well-marked dark brown marble pattern and black spots... var. *gileadensis* var. nov.

3. Seeds greyish-reddish.

a. Cotyledons yellow.

Seeds without pattern.....var. *subiberica* var. nov.

Seeds with black spots, concentrated chiefly around the hilum.

var. *maculatorubiginosa* var. nov.

b. Cotyledons orange.

Seeds without pattern.....var. *subrubiginosa* Bar.

Seeds with well-marked black marble

pattern.....var. *marmorata* Bar.

Seeds with black (dark purple) dots

var. *subthessala* var. nov.

Seeds with black spots, concentrated chief-

ly around the hilum. . . var. *transjordanica* var. nov.

Seeds with well-marked dark brown marble

pattern and black spots. . var. *philadelphica* var. nov.

II. Seeds large (6-9 mm. in diameter), flattened. Pods

large, flat (15,5-20 mm. long, 7,5-10,5

mm. width). Flowers large (7-8 mm.

long), white with blue veins, very rarely

light blue; 2-3 flowers on peduncle

ssp. *macroserma* (Baumg.) Bar.

1. Seeds yellow-green. Cotyledons yellow.

Seeds one-coloured or with dark green

marble pattern.....var. *nummularia* Al.

Seeds with black (dark purple) spots

var. *atrovirens* Bar.

2. Seeds greyish-reddish.

a. Cotyledons yellow.

Seeds without patternvar. *iberica* Bar.

b. Cotyledons orange.

Seeds without pattern.....var. *rubiginosa* Bar.

SUMMARY: The 15 varieties of the cultivated common lentil known till now for Palestine have been increased by 9 additional varieties already described, and by 18 varieties described here as new. The number of the Palestinian varieties is thus increased to 42 and the total number of the known varieties to 77.

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REVISION OF ORIENTAL SPECIES OF *PICRIS* (INCLUDING *HAGIOSERIS*) OF THE HERBARIUM OF THE HEBREW UNIVERSITY

By A. EIG

(With 8 figures in the text)

BOISSIER (1849) published the diagnosis of the genus *Hagioseris* in the *Diagnoses Plant. Orient. Nov.*, Ser. I, No. 11: 35. He added at the end of the diagnosis: "Hoc genus *Picridi* e grege *Spitzeliae* vel *Medicusiae* affine ab eis egregie differt pappo non annulato deciduo multiserialeque sed persistenti 5 paleaceo longe pulmoso plumis deciduis, involucri phyllis deciduis". In the *Flora Orientalis* 3: 741, (1875), he adds at the end of the diagnosis of *Hagioseris*: "Herbae annuae facie *Picridis* a qua phyllis a receptaculo solutis pappique paleis uniserialibus differt". The differences between *Hagioseris* and *Picris* after BOISSIER are then these: (1) the scales of the involucre of *Hagioseris* are deciduous, (2) the chaffy pappus is in one row, (3) the pappus is persistent, (4) the hairs of plumes are deciduous. BOISSIER (1849) described originally two species of the genus *Hagioseris*: *H. galilaea* ("in herbis Galilaeae") and *H. amalecitana* ("in Palaestina Arabiae contermina ad meridiem urbis Gaza").

BENTHAM and HOOKER *Gen. Plant.* 2:511 (1876) had reduced the genus *Hagioseris* to a section of *Picris*. This has been followed by HOFFMANN in ENGLER und PRANTL (1894), *Die natürl. Pflanzenfamilien* IV, 5:364. The authors of the *Kew Index* also shared this view. But all modern taxonomists who dealt with the Palestinian plants (POST, DINSMORE, BORN-MUELLER, SAMUELSSON etc.) followed the example of BOISSIER and held *Hagioseris* to be a separate genus.

As far back as six or seven years ago I had established a *Picris polymorpha* (in the Herbarium), which occupied a transitional position between the two genera and I had also arrived at the conclusion that it was impossible to keep *Hagioseris* as a separate genus. This conclusion is fully confirmed by the present revision of our oriental species of *Picris*. I shall prove it on all the differential characteristics, which BOISSIER cites to distinguish the two genera.

(1) The scales of involucre are after BOISSIER deciduous in *Hagioseris* and persistent in the genus *Picris*.

In *Hagioseris* there are two kinds of akenes: the outer (radial) and the inner (discoidal). The outer differ by their form, by their hairiness, by the short cupular pappus and by the fact that they persist a long time after ripening and fall off at the end together with the involucre scales. But we found exactly the same to be the case in the species of *Picris* of the section *Spitzelia* (at least in the Palestinian-Syrian species of this section. Compare figs. 1-4 with figs. 5-8).

In these two groups of species the appearance of the special form of the outer akenes is accompanied by the degeneration of the pappus to a crown or a cupula, by the hairiness of these outer akenes and by their being attached to the involucre leaves ("linked characteristics" of the geneticists).

(2) The chaffy pappus is after BOISSIER in one row in the genus *Hagioseris* and in several in the genus *Picris*.

In reality besides the 5 plumous pales remnants of reduced pales or hairs are also to be found in *Hagioseris* too. In *Hagioseris* (= *Picris*) *amalecitana* these pales are narrower at the base. In *Picris intermedia* there are also 5 (rarely 6-7) plumous pales of the same shape and breadth as in *H. amalecitana* and also here there are remnants of hair. Lastly, *P. damascena*, a species extremely near to *P. intermedia*, possesses 7-10 and more pales not dilated at base, and these pales are also in one row.¹ Thus also this second differential characteristic of BOISSIER is not valid..

(3) The pappus is persistent in the genus *Hagioseris*.

It is true that both species of *Hagioseris* possess persistent pappus (only the hairs of the pales are deciduous). But also in *P. damascena* and its ssp. *Blancheana* there are varieties with persistent pappus.

(4) As to the fourth characteristic of BOISSIER (the hairs of plumes are deciduous) we found it also, though to a lesser degree, in the Palestinian species of *Picris*.

Thus not one of the characteristics differentiating between the section *Spitzelia* of *Picris* and *Hagioseris* holds, and we cannot agree to keep *Hagioseris* even as a separate section of *Picris* as proposed by BENTHAM and HOOKER, our view in this point being that of HOFFMANN (ENGLER und PRANTL, 1894). The species: *Picris galilaea*

¹ NABELEK (1925). *Iter turcico-persicum*, 2: 49 reports on *Picris desertorum* Nab. (from Persia) possessing 10-12 pales with a dilated base.

(Boiss.) Benth. et Hook., *P. amalecitana* (Boiss.) Eig, *P. intermedia* Eig sp. n., *P. damascena* Boiss. et Gaill., are a natural series of species with a gradual transition, the neighbouring species being sometimes even difficult to distinguish from one another, and this series can in no way be interrupted and divided in two separate genera.

I wish to add that the Palestinian species of *Picris* show clearly the closest relation between the section *Spitzelia* and the section *Eupicris*. *P. damascena*, *P. damascena* ssp. *Blancheana* and *P. babylonica*, all possess forms with uniform akenes (i.e. formally they belong to the section *Eupicris*) and other forms with two kinds of akenes, the radial ones being typical to the sect. *Spitzelia* (thus, formally these forms belong to the sect. *Spitzelia*). Moreover we found individual plants in all these species that are transitional as to form of akenes and pappus between the typical *Spitzelia* and typical *Eupicris*. For instance, in *P. Sprengeriana* of Palestine the pappus of the outer akenes is generally only half as long as the pappus of the inner akenes, but alike in its form. Apart from that the outer akenes are sometimes hairy, as in the sect. *Spitzelia*. In *P. damascena* and *P. babylonica* there are specimens which possess only one or two outer akenes of the type of *Spitzelia*; sometimes also these akenes are sterile. In other cases we found outer akenes of the type of *Spitzelia* bearing few normal pales of the inner akenes.

Distinction of the species of the above series is difficult. We give here the differential characteristics:

(I) *P. galilaea*

Beak of the outer akenes is bent inside the head.

Outer akenes are less hairy, striae very thin.

Crown of outer akenes is slightly fringed, rigid, widely open.

Pales of inner akenes are broader at base; the intervals between them smaller.

P. amalecitana

Beak of the outer akenes is thinner, slightly bent and \pm erect.

Outer akenes are mostly more hairy, striae thicker.

Crown of outer akenes is fringed almost to base, not rigid and \pm closed.

Pales of inner akenes are narrower at the base; intervals between them wider.

Beak of inner akenes is very short.

Outer involucre leaves are fewer and mostly shorter.

Plant less rigid and less strigose.

Leaves broader.

Beak of inner akenes is distinct and longer as in *P. galilaea*.

Outer involucre leaves are more numerous and mostly longer.

Plant more rigid and more strigose.

Leaves narrower; the cauline, especially the upper ones, smaller.

(II) *P. amalecitana*

Lower half of outer akenes is thicker.

Inner akenes somewhat shorter.

Outer scales of involucre are somewhat longer.

Bracts supporting the heads are generally more numerous and more dense.

Plant taller.

Indumentum is of \pm long setae only (at the base and the upper part of the plant there are sometimes short hairs too).

Middle nerve of the scales of involucre of ripe heads is less prominent and bears generally shorter and less numerous setae.

Ripe heads are more constricted above the akenes, which are more incurved.

P. intermedia

Outer akenes thinner, less incurved and less striate.

Inner akenes somewhat longer.

Outer scales of involucre are somewhat shorter.

Bracts supporting the heads are generally less in number and less dense.

Plant smaller.

Indumentum is of two kinds: \pm long setae (generally shorter than in *P. amalecitana*) and short papillose adpressed hairs.

Middle nerve of the scales of involucre of ripe heads is very prominent and distinct by light colour and bears longer and more numerous setae.

Ripe heads are less constricted and outer akenes straighter.

(III) *P. intermedia*

Pales of Pappus 5, sometimes
6.7 \pm dilated at base.

Pappus generally persistent.

Beak of outer akenes is very
short.

Pappus of outer akenes is \pm
cupule-like and generally only
slightly paler than akenes.

P. damascena

Pales of pappus generally more
than 7, rarely 7, not dilated at
base.

Pappus generally deciduous.

Beak of outer akenes is longer
and thinner (especially in the
variety with deciduous pappus).

Pappus of outer akenes is ge-
nerally of very short hairs,
white.

Picris galilaea (Boiss.) Benth. et Hook¹—Gen. Plant. 2:511 (1876).

Figs. 1, 3.

Syn. Hagioseris galilaea Boiss.—Diagn. Plant. Orient. Nov. I,
11 : 35 (1849).

PALESTINE: Jerusalem Mountains: Jerusalem, Mt. Scopus,
(1931 A²), Kiryath Anavim (1930 Z), Deir-es-Sheikh Station (1925 E),
between Hartuv and Deir-es-Sheikh (1925 Z). Coastal Plain:
Tel-Arad (1922 E), between Kefar Uria and Hulda (1922 E), Ben-
Shemen (1922 E), Petah-Tikva (1927 *Harley*). Carmel and Lower
Galilee: Carmel, (1923 E), Nazareth (1929 *Gabrielith*), Geneigar
(1929 F), Env. of Ein Harod (1924), Kefar Yehezkiel (1924), Bithania
(1922), Tiberias (1922—all E and *Faktorovsky*). Upper Galilee:
Betw. Pekiin and Hurfesh (1926 E Z); Kefar Gileadi (1925), Deir-Mames
(1925—both *Smoly*).

¹ BENTHAM and HOOKER did not make this combination deliberately,
but they say (p. 512) discussing the species of *Picris*: "*Hagioseris* Boiss.,
Diagn. XI, 35, Walp. Ann. II, 963 est species Syriaca...". I conclude that
they had in mind *Hagioseris galilaea* and not *H. amaleciana*.

² Most of the plants mentioned were collected by members of the Botani-
cal Department of the Hebrew University the names of whom are indicated
by the following abbreviations: A—AMDURSKI, E—EIG, F—FEINBRUN,
G—GRIZI, Z—ZOHARY.

The specimen of Petah-Tikva (1927 *Harlev*), named by SAMUELSSON¹ *H. amalecitana*, is certainly *P. galilaea*. The specimen of Tel-Arad (1922 *E*), named also by SAMUELSSON *H. amalecitana*, is probably *H. galilaea*, according to the form of the outer akenes. But the narrow stem leaves and the bracts are typical of *H. amalecitana*. Also according to the locality it is rather *H. amalecitana*. So the determination of this specimen is a matter of doubt.

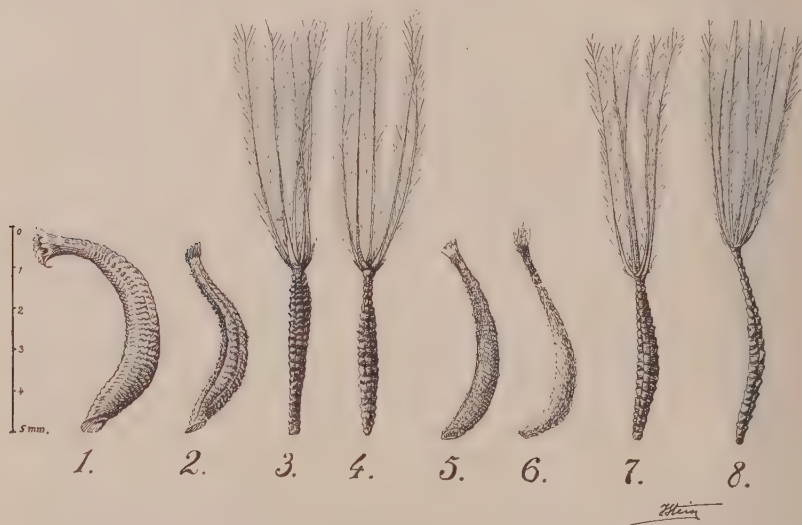
***Pieris amalecitana* (Boiss.) Eig comb. nov.**

Figs. 2, 4.

Syn. *Hagioseris amalecitana* Boiss.—Diagn. Plant. Orient. Nov. I, 11:35 (1849).

PALESTINE: Coastal Plain: Ruhama (1928 *EZF*); Gaza (1922 *E* and *Faktorovsky*), betw. Barbara and Deir-Snid (1927 *EZF*), Gan Yavneh (1937 *EZG*), Gedeira (1937 *EZG*), Beer Ya'akov (1922), Rishon-le-Zion (1922), Tel-Aviv (1922—all *E* and *Faktorovsky*), Bne Barak (1925 *E*), Ein Hai (1925 *E*), betw. Herzlia and Arsuf (1926 *Z*), Nahar-el-Falik (1927 *EZF*), Hedera (1927 *Smoly*), Benyamina (1922 *E* and *Faktorovsky*).

¹ G. SAMUELSSON revised the material on *Hagioseris* of the Herbarium of the Hebrew University. He also restored *Hagioseris amalecitana*, but unfortunately confused it with *P. intermedia* sp. n.



Figs. 1—8. Fig. 1. *Pieris galilaea*, Mt Carmel, Apr. 23, 1927. Fig. 2. *P. amalecitana*, Env. of Gedeira, June 14, 1937. Fig. 3. *P. galilaea*, Nazareth, Apr. 19, 1929. Fig. 4. *P. amalecitana*, Nahar-el-Falik, Apr. 4, 1927. Fig. 5. *P. intermedia*, 10 km. N of Jericho, March 30, 1934. Fig. 6. *P. damascena*, Judean Desert, 31 km. of Jerusalem towards Jericho, March 23, 1935. Fig. 7. *P. intermedia*, Jericho, Apr. 5, 1927. Fig. 8. *P. damascena*, Judean Desert, 31 km. of Jerusalem towards Jericho, March 23, 1935.

This species belongs geographically to the light soils of the maritime plain. It is characteristic for the associations of *Eragrostion* and also for the *Thymus capitatus-Andropogon hirtus* association of *Poterion*. It seems that even in this last association *P. amalecitana* finds its optimum of development. Ecologically then this species is clearly transitional to *P. intermedia* and also morphologically (as shown above).

The specimen of Rishon-le-Zion (1922) named by SAMUELSSON *H. galilaea*, belongs to this species, although in the form of the cauline leaves it resembles *P. galilaea*. The same is true of the specimen of Benyamina (1922).

***Picris intermedia* Eig sp. nov.**

Figs. 5, 7.

(*Picris polymorpha* sp. nov. in Herb.)

Annua, caulis striatus a basi vel altius divaricatum \pm ramosus, (5) 7—15 (25) cm. longus, cum foliis et involucri phyllis pilis patentibus, saepe glochidiatis, hirtus. Folia sinuato-denticulata vel sinuato-runcinata, radicalia oblongo-lanceolata \pm longo-petiolata, 4-8 cm. longa; caulina diminuta, sessilia, \pm auriculata. Pedunculi non incrassati, capitulis 2—5 plo longiores. Capitula erecta, mediocria, fructifera \pm constricta. Involucri phylla exteriora pauca, minuta, lanceolato-lineararia, interiorum, $1/4$ aut $1/5$ longitudinis attingentia. Phylla interiora ca. 1 cm. longa, lanceolato-lineararia, acuta, herbacea, albo-carinata, fructifera valde accreta. Flores lutei, involucri longiores. Achaenia dimorpha, 5 mm. longa, maturissima fusco-brunnea; exteriora persistentia, subincurva, adpresse hirta, inconspicue striata et transverse rugosa, cupula fimbriata superata; interiora glabra, subtiliter striata et transverse rugosa, breviter rostrata in pappum 6-7 mm. longum abeuntia; pappus persistens, albus, setis 5 (rarissime 6-7) plumosis, basi dilatatis.

PALESTINE: Negeb: N of Beersheba and betw. Beersheba a. Dahariyeh (1934 EZF). Southern Judean Desert: Bir Rotmieh (1934 F). Middle Judean Desert and E of Jerusalem: Kefar Ivri (1934 EF), Sheikh-Anbar, E. of Mt. Scopus (1935 EZG), 8, 9 a. 11 km E of Jerusalem (1934), betw. km 15-16 and 18-19 E of Jerusalem (1935), Ain Fuar, (1935—all EZF), Han Hatrur (1935 EZ), Wadi Kelt (1930 A), 24 km E of Jerusalem towards Jericho (1935 EZG). Lower Jordan Valley: 10 km N of Jericho (1934), Jericho (1927—both EZF), Wadi Zerka Main (1930 Z). Transjordan: Gilead and Belka: ascent to es-Salt (1927 EZF), es-Salt (1929 EZ), Mejdal (1929), Wadi Waran (1927), ruins of Tmeira (1927—all EZF).

The nearest species are on the one hand *P. amalecitana* and on the other *P. damascena*.

An endemic species, whose centre of distribution is the Irano-Turanian territory of the Judean Desert. Its area reaches the Mediterranean territory in Kefar Ivri in Western Palestine and Mejdal and Wadi Waran in Gilead. In general it seems to penetrate wider into the Mediterranean territory of Transjordan than into the Mediterranean territory of Cisjordan. In Transjordan it is met with in Gilead and in Belka. It is completely absent in Moab. In the Southern part of Cisjordan it is met with on the borders of the Judean Mountains and the plain of Beersheba.

***Picris intermedia* Eig var. *decidua* var. nov.**

Pappus achaenii disci deciduus.

PALESTINE: Judean Desert and Lower Jordan Valley: Wadi Kelt (1935 EZG). Jordan Valley: betw. Jericho and Dead Sea (1935 EZF).

It is rare form found only on the edge of the Saharo-Sindian territory of the Judean Desert, where it touches the area of *P. damascena*. This form, then, is a clear transition to *P. damascena* (hybrid?).

***Picris damascena* Boiss. et Gaill.—Fl. Orient. 3: 740 (1875)**

[incl. *P. Blancheana* Boiss.]

Figs. 6, 8.

PALESTINE: Southern Judean Desert: Env. of Bene Naim (1934), betw. Tekoa and Ain Gedi (1934—both EZF), Hirbeth-el-Mird (1932 EF). Middle Judean Desert: Env. of Ain-Fuar (1935 EZG), Wadi Kelt, (1932), 26 and 27 km of Jerusalem towards Jericho (1935—both EZ), 31 km of Jerusalem towards Jericho (1935 EFZ). Lower Jordan Valley: E of Allenby Bridge (1929 EZ), betw. Wadi Derajeh and Ras-Fashkha, betw. Wadi Sukf and Wadi Sidr; betw. Bir-Ghuweira and Wadi Sukf (1926—all EZF), Wadi Umbaghag, (1929 *Gabrielith*). Southern Transjordan: Amman (1929 EZ), El-Monakr-el-Karame (1927 EZF), Wadi-el-Hasa, near Qal'at-el-Hasa (1926), betw. Wadi-el-Hasa and 'Aneze (1929—both EZ). SYRIA: 21 and 34 km SW of Damascus (1933 EZ).

In Syria it is rather an Irano-Turanian species, but in Palestine, especially in comparison with *P. intermedia*, it is a Saharo-Sindian species. Thus its whole area is a Saharo-Sindian—Irano-Turanian one. In Palestine it is common in the Eastern (Saharo-Sindian) part of the Judean Desert, around the Dead Sea; the plain of Jericho and in Transjordan in Edom. In Belka it is found in the more arid part (betw. el-Muwaqqar and el-Kharana).

Besides the type we distinguish the following varieties:

***Picris damascena* Boiss. et Gaill. var. *persistens* var. nov.**

Pappus achaenii disci persistens.

PALESTINE: Judean Desert and Lower Jordan Valley: Hirbet-el-Mird (1932), 26 km. E of Jerusalem towards Jericho (1935—both EZ), Wadi Nemrin, East of Allenby Bridge (1936 EZF).

Encountered in the Saharo-Sindian part of the Judean Desert on the border of the Irano-Turanian one, and on the ascent to Salt (W. Nimrin). So this form too shows ecological and morphological relations to *P. intermedia*.

***Picris damascena* Boiss. et Gaill. var. *homocarpa* var. nov.¹**

Achaenia conformia.

PALESTINE: Southern Transjordan: betw. 'Aneze and Amman (1929 *EZF*), Wadi-el-Hasa, near Qal'at-el-Hasa (1929), 14 km S of Qal'at-el-Hasa, (1936). Lower Jordan Valley: betw. Ain Gedi and Wadi Derajeh, (1926), betw. km 31 and 32 on the way to the Dead Sea (1935—all *EZF*). SYRIA: Saube, SW of Damascus (1932 *EZ*), Tel-Chihanne, near Chaabo, N of Jebel Druze (1932), betw. Azra and Damascus (1931 *Z*).

***Picris damascena* Boiss. et Gaill. var. *diffusa* var. nov.**

Planta divaricatum diffusa.

PALESTINE: Sinai: on the border of Palestine, 14 km. N of Naqb-el-Aqaba (1936), 28 km S of el-Kossaima (1936—both *EZF*).

An interesting form, probably belonging to this species also found on the Sinai border of Palestine, at Ras-el-Naqb. The most prominent characteristic of this form is its diffuse branches, in which it resembles *P. babylonica* but is easily discernible from that latter by its akenes. Its area is separated from that of the other forms of *P. damascena*, and it grows together with *P. babylonica*.

***Picris damascena* Boiss. et Gaill. ssp. *Blancheana* (Boiss.) Eig comb. nov. Syn. *P. Blancheana* Boiss.—Fl. Or. 3: 741 (1875).**

SYRIA: Northern Syrian Desert: Jebel Mukeibra (30 km W of Soukhne) (1933), 78 km W of Soukhne (1933), 33 km SW of Deir-ez-Zor (1933—all *EZ*). IRAQ: Syrian Desert: About 300 and

¹ BOISSIER possessed specimens of this variety. The sheet with the original specimens of *Picris damascena* bears 3 labels and 5 plants. Only two specimens attached to a label with the inscription: "1. V. 1876. No. 2025. *P. pilosa* Delile. Sommet de la montagne appelée Djebel Antar, ouest de Damas, près de Mezze. C. GAILLARDOT", possess two kinds of akenes and these specimens are thus the true *P. damascena* of BOISSIER and GAILLARDOT. The other 3 specimens relating to the remaining 2 labels, collected also by GAILLARDOT in the same locality, possess uniform akenes and thus belong to our variety *homocarpa*. BOISSIER did notice it and remarked by the side of these specimens. "*achaenia longe rostrata omnea papposa*". But he failed to publish this variety in his *Flora Orientalis*. So this variety was already collected by GAILLARDOT together with the type specimens.

400 km W of Baghdad (1933), Wadi Muhammadi, about 200 km W of Baghdad (1933), 14 km and 46 km NW of Kirkuk (1933), Env. of Rihaniyah, E of Mosul (1933), Jebel Hamrin (1933—all EZ).

BOISSIER described *P. Blancheana* on the specimen from Jebel Abiad near Palmyra. The differences between the two species according to the description of BOISSIER are:

<i>P. damascena</i>	<i>P. Blancheana</i>
1) parce aspera	1) aspera
2) ascendentibus vel <i>decumbentibus</i>	2) ascendentibus vel <i>erectis</i>
3) foliis... caulinis <i>paucis minimis</i>	3) <i>lanceolato-linearibus</i> integris
4) calyculi phyllis... valde setuloso-echinatis	4) involucris phyllia setoso-strigosis
5) achaeniis... glabris striatis transverseque rugosis compressis basi subangustatis	5) radii adpresse hirtis levibus... disci transverse rugulosis
6) rostrum (of the inner akenes) eis dimidio brevius	6) rostrum achaenio subbrevius
7) setis 10.	7) setis 12-15.

BOISSIER emphasizes especially the hairy outer akenes of *P. Blancheana*, the numerous bristles of the pappus and the longer beak of the inner akenes of *P. Blancheana*. The examination of the akenes of the original specimens of *P. Blancheana* and *P. damascena* showed that the outer akenes of both types are hairy and wrinkled¹, but those of *P. Blancheana* are more prominently hairy and less prominently wrinkled. Besides, as a rule in *Picris*, when there are two types of akenes, the outer ones are more or less hairy.

The numerous specimens of *Picris* from the Syrian Desert which we ascribed to *P. Blancheana* differed from *P. damascena* only by the characteristics underlined in the above table, i.e. by the erect growth and by the comparatively long cauline leaves. So we cannot agree to keep this form as a separate species. But owing to the special geographical area of this form we propose to reduce *P. Blancheana* to a subspecies of *P. damascena*.

***Picris damascena* Boiss. et Gaill. ssp. *Blancheana* (Boiss.) Eig
var. *homomorpha* var. nov.**

Achaenia conformia.

SYRIA: Northern Syrian Desert: 78 km W of Soukhne (1933), Jebel Muqeibra, 30 km W of Soukhne (1933). IRAQ: Env. of Tauq (S of Kirkuk) (1933—all EZ).

¹ HANDEL-MAZZETTI (1913), Ann. naturhist. Hofmus. Wien, 27: 454 already mentioned that the outer akenes of *P. Blancheana* are wrinkled.

The geographic area of *P. damascena* ssp. *Blancheana* (including var. *homomorpha*) is thus the northern part of Syrian Desert and the middle adjacent part of 'Iraq.

***Picris Kotschy* Boiss.—Fl. Or. 3 : 738 (1875).**

SYRIA: Betw. Medjeleya and Eriha, (1932 EZ).

This rare species has been found only once by KOTSCHY near Aleppo. The nearest species is no doubt *P. damascena* Boiss. et Gaill.

***Picris babylonica* Hand.-Mzt.—Ann. naturhist. Hofmus. Wien.**

27 : 453 (1913).

PALESTINE: Edom: Wadi Ithm (1936), Ghuweira (betw. 'Aqaba and Ma'an). SINAI: Naqb-el-'Aqaba, (1936—all EFZ). IRAQ: Env. of Jeliba railway station (1933), env. of Ar-Rumail (Basra-Jeliba railway line) (1933), betw. at-Tuba and Annukhaila (1933), env. of Kuwaibda (1933), about 25 km SW of az-Zubair (S of Basra) (1933—all EZ).

***Picris babylonica* Hand.-Mzt. var. *dimorphocarpa* var. nov.**

Achaenia radii nonnulla \pm adpresso-hirta, superne attenuato-rostrata, cum cupula fimbriata, persistente.

SOUTHERN 'IRAQ: /Jeliba railway station (1933), 75 and 100 km. W of Basra (1933), env. of ar-Rumail (Basra-Jeliba railway line) (1933), betw. at-Tuba and Annukhaila (Basra-Jeliba railway line) (1933), betw. Kuweibda and ar-Rumail (40 km SW of Basra) (1933), 25 km of az-Zubair (S of Basra) (1933—all EZ).

HANDEL-MAZZETTI (l.c., p. 453) represents the akene of this species as being ca. 3 cm. long and says that it is twice its natural size which is thus 1.5 cm. But in the description (p. 454) he says that the akene is about 4.5 mm. long. I accepted the latter measurement and not that of the figure, which is probably erroneous. In our plants the length of the whole akene is from 4 to 5 mm., while the relative lengths of the akene and its beak are: 3 and 2, $2\frac{1}{2}$ and $1\frac{1}{2}$, 2 and 2 mm. and sometimes 3 and $1\frac{1}{2}$ mm. as in the original description. I might remark also that in our plants the flowers generally protrude for more than half a cm. from the involucre leaves. The Palestinian plants are on the whole less developed than the Iraqi.

HANDEL-MAZZETTI considered *P. babylonica* as a near species to *P. sulphurea* Del. and *P. cyanocarpa* Boiss. I cannot accept this view with regard to *P. sulphurea* (at least as far as our specimens of *P. babylonica* are concerned). *P. sulphurea* is an upright, and not diffuse, prostrate plant and the form of its akenes is distinctly other than that of the akenes of *P. baby-*

lonica.¹ But there is no doubt that *P. cyanocarpa* is the nearest species to *P. babylonica*. The akenes of both species are of the same shape, their only difference being the long beak in *P. cyanocarpa*, which is almost twice as long as in the akenes of *P. babylonica*. The description of the vegetative parts is also more or less similar. But only upon comparing the type specimens of both species will it be possible to decide whether *P. babylonica* is really a separate species or only a short-beaked variety (or subspecies) of *P. cyanocarpa*.

NABELEK, (1925—Iter turc.-pers. 2:49), published a *Picris desertorum* spec. nov. from the SW part of Persia which is according to the description and accompanying figures a species very near to *P. babylonica*. Habitually, some Palestinian specimens of *P. babylonica* approach more to the figure of NABELEK's *P. desertorum* than to that of HANDEL-MAZZETTI's *P. babylonica*, but neither in our Palestinian nor in our Iraqi specimens of *P. babylonica* did I find the dilated base of pales referred to and represented in *P. desertorum*. The question of the relation of *P. desertorum* to *P. babylonica* and *P. cyanocarpa* must be studied again on fresh and more numerous material. I repeat that I myself did not see the type specimens of either *P. desertorum* or *P. babylonica*.

***Picris radicata* (Forsk.) Less.—Syn. p. 134 (1832).**

Syn. *Crepis radicata* Forsk.—Fl. Eg. p. 145 (1775), *Leontodon coronopifolius* Desf.—Fl. Atl. 2: t. 214 (1800), *Picris coronopifolia* (Desf.) DC.—Prodr. 7: 131 (1838), *Picris lyrata* Del. and *P. pilosa* Del. — Ill. Fl. Eg. p. 116 (1819).

PALESTINE: Coastal Plain: Betw. Barbara and Deir-Snid, (1927 EZ), Mejdal (1929), env. of Ruhama (1928), Deir-Balah (1928), Han-Yunis (1928), S of Beersheba (1928—all EFZ). SINAI: el-Arish (1925 EZ). EGYPT: Alexandria (1928 E).

The hairiness of our specimens consists of intermixed barbed (glochidialis) and simple hairs. I cannot thus keep the variety *pilosa* (Del.) Asch. et Schw. The akenes of our specimens are reddish or violet. *P. radicata* is easily distinguishable from *P. Sprengeriana* by the outer akenes, which are

¹ I take this opportunity for making a remark about *P. sulphurea* which does not grow in Palestine. DELILE (1824), in the original description (Fl. Eg., p. 334), says about the akenes of the same: "Les graines... sont... rétrécies et acuminées sous l'aigrette, qui se détache d'elle-même de ce sommet". —BOISSIER (1875, Fl. Or, 3:734) separates *P. sulphurea* from the other annual species of the section on the ground of its pappus being persistent. In the description (p. 739) he says: "Achaeniis... cylindricis apice in rostrum... sensim attenuatis". As far as I could find from my examination of this species on the specimens of Cairo (locus classicus!), the data of BOISSIER are more nearly correct.

glabrous, longitudinally and transversely striate and with deciduous pappus, whereas the outer akenes of *P. radicata* are hairy, striate only longitudinally and with a more or less persistent pappus.

***Picris Sprengeriana* (L.) Poir. — Dict. 5 : 310 (1804).**

PALESTINE: Coastal Plain: Gaza (1924 *E*, *Faktorovsky*), env. of Gedeira (1937 *EGZ*), Ben-Shemen (1933 *E*), env. of Latrun (1929), *Benei-Barak* (1926—both *FZ*), Petah-Tikva (1922 *E*, *Faktorovsky*), Nahar-el-Falik (1929 *EFZ*), Kabbara (1926 *EZ*). Judean Mountains: Dahariyeh (1927 *EFZ*), Jerusalem (1926 *EZ*), Motsa (1925), Qiryat-Anavim (1930—both *Z*), Deir-es-Sheikh (1931 *EZ*), betw. Jerusalem and Nablus (1924 *E*), Jordan Valley: banks of the Jordan near Wadi Faraa, Wadi Faraa, betw. Faraa and Beisan (1934), Naharayim (1933—all *EFZ*). Lower Galilee: env. of Balfouria (1926), Kefar Yehezkiel (1926—both *Z*), Kinnereth (1923), Yavneel (1924—both *E*, *Faktorovsky*). Upper Galilee: banks of Wadi Qarn (1926 *EZ*), Jebel Jermak (1925 *E*), Wadi Tawahin (1926 *EZ*), Metulla (1924), valley of Ayun (1924—both *E*, *Faktorovsky*). Transjordania: Mejdal (1927 *EFZ*), ascent to es-Salt (1927), betw. el-Hasa and 'Aneze (1929—both *EZ*). SYRIA: Lebanon: Shibanieh (1924 *E*, *Faktorovsky*), betw. Hasroun and Bakafra, 1300-1500 m. (1931 *Z*). Northern Syria: Jebel Arbain, env. of Eriha (1932), betw. Bellet-e-Sherieh and el-Ourdu (1932), Amanus Mountains, env. of Akilyeh (1932), Karagouz (1932—all *EZ*), S of Kessab and Kosseir (1935 *Delbes*). CYPRUS: Mt. Troodos (1937 *G*).

This species is clearly a Mediterranean one. In the light soil belt of the Palestinian coastal plain it is encountered rather seldom, but it is one of the commonest of annual species in the other parts of the Mediterranean territories of Palestine.

***Picris strigosa* M.B. — Fl. Taur. Cauc. 2 : 250 (1808).**

SYRIA: Hermon: Shiba, ca. 1200 m. (1924), Rashieh, ca. 1400 m (1924), Ain Jina, ca. 1800 m. (1924—all *E*), Kasr Antr (1929 *Gabrielith*). Southern Lebanon: Shibanieh (1924 *E*). Northern Lebanon: above Ehden (1931 *EZ*), betw. Hasroun and Bakafra (1931 *Z*), above Bescherra (1931), Karnet-es-Souda (1931—both *EZ*), betw. Ain-el-Barkawiyeh and Ain-el-Dib (1934 *EEFZ*). Coelesyria: ca. 10 km S of Baalbeck (1934), Maaqne, N of Baalbeck (1934—both *EEFZ*). Northern Syria: Sersikol near Alexandretta (1931). IRAQ: Iraqi Kurdistan: env. of Rayat (1933 *EFZ*).

***Picris spinulosa* Bertol. — in Guss. Syn. 2 : 400 (1844).**

NORTHERN SYRIA: Amanus Mts.: betw. Akil-yeh and Karakisieh (1932), Karagouz (1932), Col of Celdrin, betw. the villages Celdrin and Bujuk Aba (1931—all *EZ*).

KEY TO THE PALESTINIAN AND SYRIAN SPECIES OF *Picris*
(incl. *Hagioseris*).

1. Biennials (or perennants) usually tall herbs. Only in Syria ... 2
- Annuals 2
2. Akenes 5-6 mm long with short beak. Stems acutely striate, angular. The whole of Syria, especially mountains
P. strigosa M. B.
- Akenes 3-3,5 mm long; stems not or scarcely striate. Northern Syria, especially mountains *P. spinulosa* Bertol.
- 3(1). Pales of pappus 5 (rarely 6-7) 4
- Pales or bristles of appus 8 or more 6
4. Crown of outer akenes rigid, widely open, cupule-like with fringed margin; beak of outer akene thick, short and strongly incurved. Mediterranean territories of Palestine and Southern adjacent parts of Mediterranean territories of Syria *P. galilaea* (Boiss.) Benth. et Hook.
- Crown of outer akenes fringed almost to base or formed of short hairs, closed or behalf-closed 5
5. Indumentum, at least on the middle parts of the plant, of bristles only; middle nerve of the scales of involucre of \pm ripe head not very prominent; plumae of the upper part of the scales of pappus deciduous. Plant of the light soil of the costal plain of Palestine
P. amalecitana (Boiss.) Eig
- Indumentum of two kinds: \pm long setae and short papillose hairs; middle nerve of the scales of involucre of \pm ripe heads is very prominent and distinguished by light colour. Plants of the Irano-Turanian territories of Trans- and Cisjordania *P. intermedia* Eig
- 6(3). Inner akenes small (2-3,5 mm.). Beak none or very short ($\frac{1}{4}$ of the length of akene) 7
- Inner akenes with long beak ($\frac{1}{2}$ or more of the length of akene); akene with the beak longer than 4 mm. 8
7. Pappus of outer akenes persistent; outer akenes wrinkled only longitudinally. Lower leaves deeply sinuate-pinnatifid. Plants of the southern part of the coastal plain of Palestine *P. radicata* (Forsk.) Less.

- Pappus of outer akenes deciduous; outer akenes longitudinally and transversely wrinkled; lower leaves sinuate-toothed. Plants of the Mediterranean territories of Palestine and Syria.....*P. Sprengeriana* (L.) Poir.
- 8(6). Inner akenes 2-3 mm long (without beak) suddenly constricted beneath the back..... 9
- Inner akenes longer, gradually tapering to beak..... 10
- 9. Beak twice or about twice as long as akene. Borders of Sinai.....*P. cyanocarpa* Boiss.
- Beak as long or shorter than akene. Edom and Sinai on the border of Palestine *P. babylonica* Hand.-Mzt.
- 10(8). Pappus of outer akenes about half as long as that of the inner ones; bristles of pappus numerous; fruiting peduncles gradually thickening above. Inner Syria
P. Kotschy Boiss.
- Pappus of outer akenes very short, sometimes all the akenes conform. Irano-Turanian parts of Syria and Saharo-Sindian parts of Western Palestine and Edom
P. damascena Boiss. et Gaill.

STIGMATELLA, A NEW GENUS OF CRUCIFERAE

By A. EIG

(With 12 figures in the text)

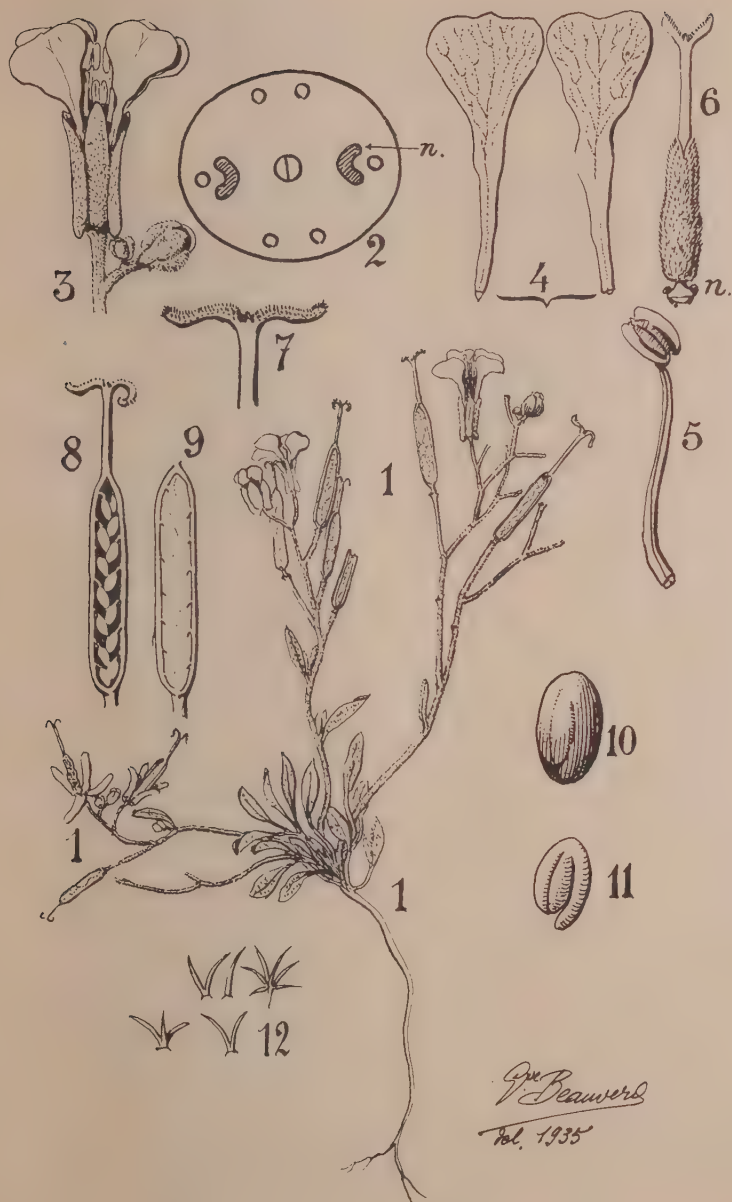
Stigmatella gen. nov.

Sepala erecta, linearia, basi saccata. Petala unguiculata. Stamina 6, libera, filamenta ad basin vix dilatata. Glandulae nectariferae, laterales, latere interiore filamentorum sitae, medianae nullae. Pistillum cylindricum substipitatum. Stylus manifestus. Stigmata bina, longissima. Siliquae lineares, teretiusculae, biloculares, septigerae, bivalves, cito dehiscentes, valvis nervo medio parcurrentibus. Semina biseriata, notarrhiza. Planta annua, humilis, habitu *Maresiae*, pilis ramosis oblecta.

Stigmatella longistyla sp. nov.

Planta annua, tota pilis ramosis oblecta, cinerescens. Caulis humilis, a basi ramosissimus. Rami 3-6 cm. longi, subnudi. Folia pleraque rosulata, spathulata, longopetiolata, integra vel subrepanda, rare minute dentada, 10-15 (20) mm. longa, apice obtuso, caulina pauca, saepe nulla, sessilia, oblonga. Racemi 3-6 flori. Pedicelli 3-6 mm. longi. Sepala 4-5 mm. longa; exteriora oblongo-lineararia, obtusa, interiora subnavicularia, albo-marginata, paulo-minora, subacuta, basi parum saccata. Petala lilacina, 8 mm. longa, lamina obtriangulata, apice rotundato-truncato vel subretuso in unguiculum linearem lamina sesquilongiore contracta. Stamina 4-5 mm. longa, antherae 1,5 mm. longae. Glandulae nectariferae laterales, latere interiore filamentorum sitae, semilunatae. Ovarium stellato-pilosum, ovula 24-30. Stylus 3 mm. longus. Stigma profunde bilobum, lobis linearibus $3/4$ —1 mm. longis. Siliquae 15-18 mm. longae erecto-patentes, lineares, tereti-subcompressae, torulosae. Semina ovoidea, 1 mm. longa.

Figs. 1-12. *Stigmatella longistyla* sp. nov. Fig. 1. General aspect of the plant. Fig. 2. Floral diagram showing position of nectaria (n). Fig. 3. Flower. Fig. 4. Petals. Fig. 5. Stamen. Fig. 6. Pistil, n—nectarium. Fig. 7. Stigmas during anthesis. Fig. 8. An open siliqua. Fig. 9. Septum. Fig. 10. Seed. Fig. 11. Embryo. Fig. 12. Hairs.



PALESTINE: Transjordan, Edom: 40 km. S of Maan, sandy fields (1929 Eig, Zohary), there, el-Hesma, 22 km N of Gweira, in the assoc. of *Zilla spinosa*—*Noea mucronata*, sandy soil (1936 Eig, Evenari, Feinbrun), there, env. of Petra, Nubian sandstone (1936 Zohary).

I first supposed I had before me a new species of the genus *Maresia*. Accordingly it was classed in the Herbarium as *Maresia longistyla* Eig. But later on I found that it differs from *Maresia* in certain important features, chiefly in the long linear stigmas, but also in the two rows of seeds and short stipitate ovary. If it were classed in the genus *Maresia* the name should be *Maresia longistyla* Eig.

Phytogeographically this is a pure Saharo-Sindian species and approaches in this respect *Maresia pygmaea*, a Saharo-Sindian-Mediterranean species. Like the species of the genus *Maresia*, *Stigmatella* is also a plant growing in sandy soil. Geographically it is also close to *Maresia*. In the same association of *Zilla spinosa*—*Noea mucronata* we found *Maresia pygmaea*, but only rarely and in poor specimens.

MOSHEOVIA,¹ A NEW GENUS OF *SCROPHULARIACEAE*

By A. EIG

(With 19 figures in the text)

Mosheovia gen. nov.

Calyx quinquefidus, post anthesem acrescens, lobis oblongis, brevissime et late acuminatis, emarginatis, fructo longioribus. Stamina quina, omnia ad basim tubo inserta, unum staminodium sterile, lineare, cetera fertilia, bina longiora; antherarum loculi in unum transversum confluentes. Corollae duo lobi superiores tres inferiores tegunt. Capsula oblongo ventricosa, acuta, septicida, valvae integrae; semina ovoideo-rugosa. Herba annua, folia inferiora opposita, cetera alterna. Flores in axillis singules. Pubes simplex, capitata.

Mosheovia galilaea sp. nov.

Annuus, 10-40 cm altus, caulis erectus simplex, unicus, (non ramosus), quadrangulus, inferne subalatus, totus + hirtulus, pubes capitata. Folia opaca, praeter infima subintegra, dentata, hirtula, cum nervo mediano subtus prominente, inferiora opposita, cetera sparsa; infima (radicalia) ovata, petiolata, petiolis ca. 2 cm. longis basi amplexicauli; media oblongo-ovata, subamplexicaulia, e basi latiore ovata; suprema oblongo ovata. Inflorescentia ex axillis foliorum sparsorum uniflora, petiolis 0,5-1 cm. longis. Calyx ca. 7 mm longus, fructifer conspicue acrescens, herbaceus, viridis, glanduloso-puberulis, profunde quinque-partitus, lobis tubo 4-5 plo longioribus, oblongis, brevissime et late acuminatis, emarginatis. Corolla 9-10 mm longa, flava (?), urceolata, quinque-loba. Staminodium lineare ad basim tubi insertum. Stamina inaequalia, inclusa. Nectarium annulare, ovarii basim cingens. Ovarium ovato-pyriforme; stylus filiformis, elongatus; stigma bilobum. Capsula oblongo-ventricosa, acuta glaberrima, semina ca. 65.

PALESTINE: Upper Galilee: Between Rosh-Pina and Ayeleth Hashahar (1930 *Gundelman*), Tel-Hai (1925) and Kefar Gileadi (1925- both *Smoly*).

¹ Dedicated to the late Gershon Mosheov.

Having at first only the very incomplete material collected by GUNDEL-MAN, I supposed I had before me a new species of a new section of *Scrophularia* (*Scrophularia galilaea* sp. nov. of a new section "*Acrescens*" in Herb.), but upon receipt of the fresh material of SMOLY I considered it better to keep this new species as a separate genus. In habitus, it approaches especially *Scrophularia arguta* Sol. and *S. calycina* Benth, but also *S. chrysantha* Jab. et Sp. and 1-2 other species of this genus.

There is no very sharp characteristic which alone is sufficient to distinguish the new genus from the genus *Scrophularia*, but there is an ensemble of several characteristics, which are met with only rarely in *Scrophularia*.

The most important of these distinguishing characteristics: (1) the one-flowered inflorescence, (2) the staminodium is linear and inserted at the base of the corolla, (3) the acrescent calyx in fruit, its form and the absence of the margin, are a rare exception in the genus *Scrophularia*, (4) the form of the fruit too is non-characteristic for the genus *Scrophularia*, (5) the stigma is markedly bifid, (5) an annual plant not at all branching (having only one stem). These characteristics may be found in one species of *Scrophularia* or another, but when together, they form a type hardly to be included in *Scrophularia*. I may add, that I did not find a calyx really acrescent in fruit among those *Scrophularia* which I examined in several big European Herbaria. Nor did I see a *Scrophularia* species with a one-flowered inflorescence, although *S. uniflora* Richter and *S. Ruprechtii* Boiss. are described as one-flowered.

Figs. 1—19. *Mosheovia galilaea* sp. nov. Fig. 1. General aspect of the plant. Fig. 2. Floral diagram. Fig. 3. Longitudinal section of the flower, std — staminodium, st — two lipped stigma. Fig. 4. Ovary. Fig. 5. Longitudinal section of the ovary. Fig. 6. Placenta. Figs. 7, 8. Seeds. Figs. 9, 10. Anthers. Fig. 11. Calyx with pistil, n — nectary, st — two lipped stigma. Fig. 12. Flower. Fig. 13. Corolla en face. Fig. 14. Corolla showing the insertion of the stamens, std — staminodium. Fig. 15. Hairs of calyx lobes (simple capitate hairs). Fig. 16. Hairs of corolla (small, simple and biarticulate). Figs. 17, 18. Hairs of *Scrophularia vernalis* for comparison. Fig. 19. Longitudinal section of a flower of *Scrophularia lucida* for comparison, std — staminodium, st — stigma.



NOTES

THE INFLUENCE OF THE WATER EXTRACT OF
WHEAT SEEDS UPON THEIR GERMINATION
AND GROWTHBY GERSHON MOSHEOV¹

INTRODUCTION

OPPENHEIMER (1922 a, b) was the first to conduct a systematic investigation on the influence of the inhibiting substances present in various fruits upon germination.² In OPPENHEIMER's experiments succulent fruit seemed to contain germination inhibitors. He worked at first with *Solanum Lycopersicum*, but subsequently found an inhibiting influence in the fruit peel and pulp of a large number of plants, both succulent and dry. His experiments were repeated by REINHARD (1933) and in a modified form by KOECKEMANN (1934, 1936 b).

In addition to these substances, which are present in the pulp or peel of fruit, inhibiting substances may be found also in the testa or in the seed itself. It is known that the influence of these substances can be abolished by various chemical or physical means. (See LEHMANN and AICHELE, 1931. *Keimungsphysiologie der Graeser*. Stuttgart).

Our experiments dealt with inhibiting substances which are present in the external parts of wheat seeds. The work of SCHROEDER (1911), COLLINS (1918) and SCHANDER (1934) based on the permeation method indicates that the penetration of fluids into the seed occurs first of all into the parts surrounding the embryo. Since in our experiments the immersion time of the seeds was brief, it may be inferred that the substances extracted came only from parts surrounding the embryo.

¹ GERSHON MOSHEOV, the author of the two papers which are here published, was seriously wounded, while on guard-duty at Kiriat Anavim, a Jewish agricultural holding near Jerusalem, during a firing attack by Arabs on August 17th, 1936. After 3 days of great sufferings, he died, being then 23 years of age. A short sketch on his personality is given in the end of this number.

² According to KOECKEMANN (1936a) the inhibiting influence of fruit juice upon germination was already known to ALBERTUS MAGNUS (1193-1280).

METHOD

Selected wheat seeds are weighed, and allowed to stand in a definite quantity of water for a definite time (1—2 hours). At the end of this time the water extract is poured off and filtered through filter paper. A number of the extracted seeds, after they have been wiped on clean filter paper, are placed in Petri dishes (24 seeds per Petri dish), padded with a single layer of filter paper. The seeds in some of the Petri dishes are provided with water extract; the remainder receive water for a control.

INFLUENCE OF WATER EXTRACT UPON GERMINATION

Experiment 1.

20 g of wheat seeds were immersed in 50 ml of water for half an hour. 50 of the seeds were divided between 2 Petri dishes containing water extract, and 50 were placed in control Petri dishes containing water.

Date	Water control	Water extract	Remarks
6.6.35	—	—	Beginning of experiment
7.6.35	12	—	Number of seeds germinated
10.6.35	5	5.1	Average length of leaves

INFLUENCE OF VARIOUS CONCENTRATIONS OF WATER EXTRACT
UPON THE GERMINATION*Experiment 2.*

50 g of wheat seed were allowed to stand in 50 ml of distilled water for 15 mins. The water extract thus obtained was diluted to various degrees and the influence of the various concentrations on germination was tested.

Date	Water control	undiluted	Water extract 1/2 conc.	1/4 conc.	Remarks
15.6.	—	—	—	—	Beginning of experiment
16.6.	11	2	9	9	Tiny roots appear
16.6.	3	16	12	12	Failed to germinate
17.6.	46	32	37	36	Leaflets appeared
17.6.	49	42	47	46	Germinated

Experiment 3.

Seeds were watered with extracts obtained from

- (a) 40 g of wheat in 50 ml of water for 20 mins.
- (b) 20 g of wheat in 50 ml of water for 20 mins.
- (c) 10 g of wheat in 50 ml of water for 20 mins.

The seeds were germinated in Petri dishes containing 25 seeds each.

Date	Time	a	b	c	Water control	Remarks
11.6.		—	—	—	—	Beginning of experiment
12.6.	8 a.m.	—	3	18	7 ¹	Number of seeds germinated
12.6.	5½ p.m.	15	28	39	45	Number of seeds germinated
13.6.	10 a.m.	28	36	39	43	Numb. of coleoptiles put forth
16.6.		+++	++	+	+	Length of seedlings

¹ The Petridishes dried.

It appears from^o the above experiments that :—

(a) The inhibitive influence on germination is stronger, the more concentrated the extract,

(b) After a number of days, the extract causes an appreciable stimulation.

Experiment 4.

(a) 30 g wheat were suspended in 50 ml water for one half hour, and 50 of the seeds were then placed in Petri dishes.

(b) 20 g wheat were suspended in 50 ml water for one half hour, and 50 of the seeds were then placed in Petri dishes.

(a) and (b) batches were provided with their respective extracts during germination.

Date	Time	a	b	Water control	Remarks
10.6	3 p.m.	—	—	—	Beginning of experiment
11.6.	7 a.m.	—	3	7	Number of seeds germinated
11.6.	3 p.m.	2	10	22	"
12.6.	8 a.m.	24	26	31	Number of coleoptiles
"	"	3	2	2	Did not germinate
"	"	++	+	+	Length of roots
14.6.	"	no differences			Length of leaves

Experiment 5.

Seeds were germinated under glass bells, as in the method described above (60 g of seed suspended in 100 ml of water for 15 mins, 50 seeds under each bell). The bells were covered with paper. Every 2 days, the same quantity of water extract was added. Extract was prepared from the seeds in the same way throughout, viz. 60 g of seed in 100 ml of water for 15 mins.

Date	Water control	Water extract	Remarks
22.7.	—	—	Beginning of experiment
24.7.	28	12	3 roots put forth
25.7.	47	21	Number of seeds germinated
"	37	11	Produced separate coleoptiles
26.7.	3	10	Failed to put forth leaflets
28.7.	100%	100%	Germinated
"	"	"	Number bearing leaves
"	+	++	Average size of leaves

GERMINATION UNDER STERILE CONDITIONS

Experiment 6.

Frequently bacteria develop in the extract and cause a reduction in the pH. This change is only effected after several days, but for greater certainty, a sterile germination experiment was made.

Petri dishes and other apparatus were sterilised in a steriliser.

Sterilisation of the seeds: It was at first attempted to sterilise the seeds by immersing them in CuSO_4 $\frac{1}{2}\%$ for one half hour. This method was found to be unsuitable both because it did not effect complete sterilisation, and because the CuSO_4 acts as an inhibitor of germination.

The best method is that of SCHANDER. Accordingly, the seeds were suspended for $\frac{3}{4}$ of an hour in 3% H_2O_2 . The sterilisation of the extract was effected by means of filtering through a Seitz filter. As a control two sterilized seeds were introduced into the sterile extract in test tubes. During five days these sterilised extracts remained pure. Unsterilized extracts under the same conditions turned cloudy. In view of this observation it was concluded that the sterilization method used by us was effective.

The seeds were divided among 4 Petri dishes, each containing 21 seeds.

The control dishes contained each 20 seeds.

Date	Water extract	Water	Remarks
14.8.	—	—	Beginning of experiment
15.8.	—	13	Number of seeds germinated
16.8.	28	53	"
16.8.	20	6	Did not germinate
18.8.	no differences		
19.8.	"	"	
20.8.	++	+	Length of seedlings.

HEAT INACTIVATION OF THE INHIBITING SUBSTANCES

Experiment 7.

40 g of wheat seeds were suspended in 40 ml of water for 20 mins. The water extract was heated for one half hour in boiling water. The volume was thereby reduced to 20 ml and was then restored to 50 ml.

50 seeds were placed in 2 Petri dishes.

Date	Time	Water extract	Water	Remarks
13.6.	2 p.m.	—	—	Beginning of experiment
14.6.	1 p.m.	6	7	Number of seeds germinated
"	3 p.m.	16	15	"
15.6.		35	40	Number of coleoptiles
"		100%	100%	Germinated

Experiment 8.

The water extract was boiled for one half hour and was compared with unboiled water extract.

Date	Water	Unboiled water extract	Boiled water extract	Remarks
8.8.	—	—	—	Beginning of experiment
9.8.	17	10	22	Number of seeds germinated
12.8.	+	++	++	Size

This experiment shows that the inhibiting substance is destroyed by extended boiling. The stimulation however is not destroyed.

INFLUENCE OF LIGHT ON THE SEED EXTRACT

Experiment 9.

20 g of wheat seed were extracted in 30 ml of water for one hour.

Date	Light		Darkness		Remarks
	Water	Water extr.	Water	Water extr.	
29.7.	—	—	—	—	Beginning of experiment
30.7.	9	3	10	6	Number of seeds germinated
31.7.	48	43	50	50	"
1.8.	No differences				

Experiment 10.

20 g of wheat seeds were suspended in 30 ml of water for one hour.

Date	Light		Darkness		Remarks
	Water	Water extr.	Water	Water extr.	
1.8.	—	—	—	—	Beginning of experiment
2.8.	12	—	14	14	Number of seeds germinated
4.8.	No differences				
6.8.	+	++	+	++	Size

It may be concluded that the extract inhibits germination largely in light. In the dark, the inhibition is either abolished or weakened.

EXPERIMENTS UPON THE STIMULATIVE INFLUENCE OF THE WATER EXTRACT

Experiment 11.

On 10.9., the seeds were suspended in water for one hour and set away for germination. On 13.9., the seeds were cut away, leaving only the seedlings. 50 seedlings were placed under each bell (3 bells). One lot was watered with water, a second with water extract, and a third with Knopp's solution. On 17.9., the lot watered with Knopp solution seemed significantly the better developed. On 23.9., the largest sizes were found in the Knopp solution lot and in the seed extract lot. From this experiment it follows that the stimulating effect of the seed extract is due to the presence of nutrients, — possibly parts of the endosperm which can be utilised by the plant for food—in the extract.

INFLUENCE OF DIALYSED WATER EXTRACT

Experiment 12.

The seeds were suspended in water for one hour, and divided between 2 bells. One lot was watered with undialysed water extract, and the second with dialysed water extract. The experiment seemed to show that the growth in the case of the dialysed extract was superior by far to that in the case of the undialysed.

SUMMARY

(1) It is shown by experiments that the external parts of wheat seeds contain a germination inhibiting substance.

(2) This inhibiting substance is thermolabile and is destroyed on extended boiling.

(3) The inhibiting action of this substance is stronger in the light than in the dark.

(4) Water extract prepared by suspending seeds in water also contains a substance which after a certain time interval (3—4 days) leads to a stimulation. This substance is probably different from the inhibiting substance. After watering for 20 days with the water extract, pronounced size differences between plants given water extract and plants given plain water are evident.

(5) The stimulating substance is in colloidal dispersion and thermostable. Its influence seems to be mainly that of a nutriment. Conclusive experiments on this point have not yet however been conducted.

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THE INHIBITION OF GERMINATION AND ROOT FORMATION BY COPPER SULFATE AND THE ELIMINATION OF THE INHIBITORY EFFECT

By GERSHON MOSHEOV

(With Plate V)

In the course of experiments on inhibiting substances in the seed coat of wheat seeds, the sterilization of the latter appeared desirable. To this end, the influence of 1% CuSO_4 solution was tried. This treatment resulted in the usual inhibition injury, that has long been known (NEUWEILER, 1928; LEHMANN u. AICHELE, 1931; PLAUT, 1932).

The injury was manifested in:

- (1) delayed germination,
- (2) reduced germination percentage,
- (3) lack of roots during the primary phase of the seedlings' development (7—8 days).

In the course of further experiments it was found that the influence of copper on germination can be eliminated under certain conditions.

These results are described in the present paper.

At first we were of the opinion that the failure to form roots after the CuSO_4 treatment is due to the fact that this reagent inhibits the action of root-forming substances (WENT, 1932; BOUILLENNE and WENT, 1933), but does not interfere with stem formation. Accordingly, we undertook a series of experiments, whose objective it was to find substances whose application to poisoned seeds would restore their root forming ability. These substances were sought in:

- (a) extracts of various organs of various plants (press juice or water macerates),
- (b) auxin preparations, and
- (c) water in which cuttings had been rooted.

EXPERIMENT I.

THE INFLUENCE OF PRESS-JUICE OF POTATOES ON THE GERMINATION AND DEVELOPMENT OF COPPER SULFATE POISONED SEEDS

20 g of *Triticum durum* seeds were steeped in CuSO_4 solution 1%, for half an hour, then washed under the tap, and left to stand

in distilled water for 15 minutes. The seeds were germinated in batches of 25 on blotting paper in Petri dishes, and received measured quantities of press-juice of potatoes. Control seeds were watered with similar volumes of distilled water.

Table 1.
(one of 7 experiments)

	Water control Out of 75 seeds	Potato juice Out of 75 seeds	Time	Note
Number showing signs of germination	3	68	29.XII 1.I.36	Beginning of ex- periment.
Number germinated ¹	12	72	2.I.36	In most cases the coleoptile is put forth before the radicle. Seeds wa- tered with potato press juice form much larger cole- optiles.
Number bearing coleoptile	15	72	6.I.36	
Number with normal roots	—	7	6.I.36	

The figures show that press-juice of potatoes (a) increases the percentage germination, (b) stimulates coleoptile formation.

EXPERIMENT II.

THE INFLUENCE OF WATER MACERATE OF WHEAT LEAVES ON THE GERMINATION AND ROOT-FORMATION OF POISONED SEEDS

20 g of *Triticum durum* seeds were steeped in CuSO_4 1% for half an hour, then washed under the tap, and steeped in distilled water for 15 minutes. The treated seeds were germinated in batches of 25 seeds on blotting paper in Petri dishes. Part of the experiment seeds were provided with filtered water macerate of wheat leaves (1,4 g in 20 cc. water); a second part with filtered water macerate of wheat roots (1,4 g in 20 cc. water).

¹ Seeds which have put forth a coleoptile or radicle which is at least half as long as the seed.

Table 2.
(One of 3 experiments)

	Water control Out of 75 seeds	Wa. mac. of wheat leaves Out of 75 seeds	Wa. mac. of wheat roots Out of 75 seeds	Time
Beginning	—	—	—	26.I
Number germinated	17	53	54	28.I
Number hoots formed	0	22	25	2.II
Number normal three roots formed	0	16	13	2.II
Number with roots longer than 3 cm.	0	33	26	2.II

Note : 5.2.36. The seedlings watered with the leaf extract are much longer.

The results indicate that wheat leaf and wheat root extracts not only increase the percentage germination of the poisoned seeds, but in large measure also restore their root forming ability.

EXPERIMENT III.

20 g of *Triticum durum* seeds were steeped in CuSO_4 1% for 15 minutes, then washed, steeped in distilled water, and allowed to germinate as in experiment I and II. Part of the experiment seeds were watered with filtered macerate of *Allium cepa* leaves (7,5 g in 20 cc. water), a second part with filtered press juice of potatoes.

Table 3.
(one of 3 experiments)

	Wa mac. of <i>Allium</i> leaves Out of 150 seeds	Press juice of potatoes Out of 150 seeds	Water control Out of 150 seeds	Time
Beginning	—	—	—	12.III
Number germinated	128	40	13	17.III

(The plants were photographed on the 20.III, see Plate V. Fig. 1. a—seeds watered by wa. mac. of *Allium cepa* leaves ; b—seeds watered by press juice of potatoes ; c—water control ; d—normal seeds).

The experiment indicates that macerate of *Allium cepa* leaves as well as press juice of potatoes increases the percentage germination

of poisoned seeds. The *Allium cepa* macerate also largely restores the root-forming ability.

EXPERIMENT IV.

THE INFLUENCE OF WATER MACERATE OF *CYNODON DACTYLON* LEAVES ON THE GERMINATION AND ROOT FORMATION OF POISONED SEEDS

20 g of *Triticum durum* seeds were steeped in CuSO_4 1% for 1 hour, then washed, steeped in distilled water, and germinated as in experiments I and II. The experiment seeds were watered with filtered water macerate of *Cynodon dactylon* leaves (20 g leaves in 100 cc. water).

Table 4.
(one of 2 experiments).

	Water control Out of 250 seeds	<i>Cynodon dactylon</i> macerate Out of 250 seeds	Time
Beginning	—	—	27.VII
Number germinated	2	60	29.VII
" "	52	143	30.VII
Number with roots larger than 5 mm	16	139	"
Number of seeds gave roots	12	76	"
Number germinated	78	182	31.VII
Number with roots larger than 5 mm	34	233	"

The experiment indicates that the water macerate of *Cynodon dactylon* has a powerful favourable influence on the percentage germination of the seeds, and almost fully restores their root-forming ability.

Similar experiments were carried out with *Setaria verticillata*, *Pisum sativum*. Similar results were obtained. The leaves of *Pisum sativum* seem to be the least effective.

EXPERIMENT V.

INFLUENCE OF AUXIN SOLUTIONS ON THE GERMINATION AND ROOT FORMATION OF POISONED SEEDS

Solutions of heteroauxin of the following concentrations were prepared: 5 mg heteroauxin in 50, 150, 200, 400, 800, 1600, 3200 cc. distilled water. The poisoned seeds were watered with these solutions according to the method described above. No activation was observed.



Fig. 1

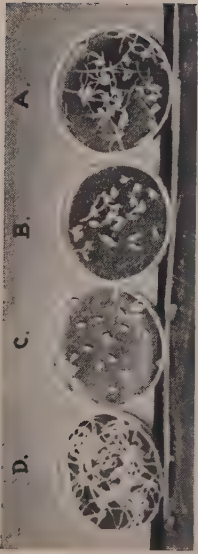


Fig. 2

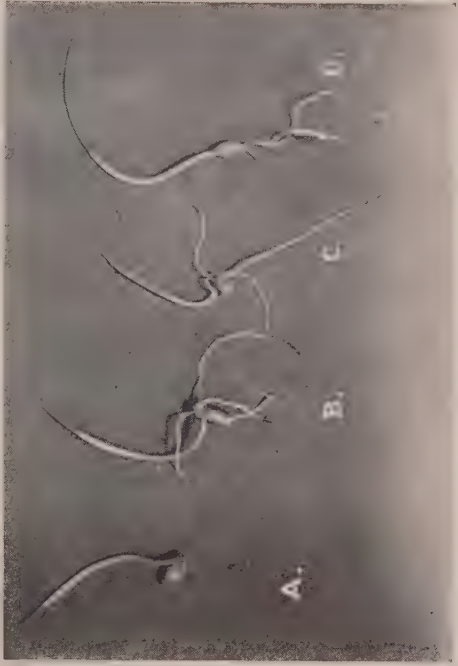


Fig. 3



Fig. 4

EXPERIMENT VI.

INFLUENCE OF BOILED AND NORMAL MACERATE OF *CYNODON*
LEAVES ON THE GERMINATION AND ROOT FORMATION OF
POISONED SEEDS

Macerate of *Cynodon dactylon* was prepared as follows: 20 g of the leaves were ground in 100 cc. water and filtered. The filtrate was boiled for 10 minutes. The boiled filtrate was refiltered and restored to its original volume by addition of water. The solution was tried on treated seeds (*Triticum durum* seeds steeped in CuSO_4 2% for 1 hour, washed and germinated as described above in experiments I and II). Solutions and blotting paper were daily removed so as to prevent decay.

Table 5.
(one of 2 experiments).

	Boiled macerate Out of 150 seeds	Normal mac. Out of 150 seeds	Water control Out of 200 seeds	Time
Beginning	—	—	—	23.VII
Number showing signs of germination	2	10	2	30.VII
Number germinated	65	75	35	31.VII
Number of roots	320	388	54	2.VIII
Number of seeds with roots	110	130	16	2.VIII
Number of roots	Very many	Very many	190	6.VIII

Note:— The general development of the seedlings was better when watered with unboiled extract than with boiled.

(We took a picture of this experiment on the 4.VIII, Plate V. Figs. 2 and 3. a—seeds watered with normal water macerate of *Cynodon dactylon*; b—seeds watered with boiled water macerate of *Cynodon dactylon*; c—water control).

The experiment showed that (a) the substance causing root formation by poisoned seeds (CuSO_4) resists boiling in water for 10 minutes, and (b) roots are formed after a period of 9 days also by seeds that received only pure water. These roots generally appear only at the base of the coleoptile.

EXPERIMENT VII.

To 20 cc. of water macerate (prepared as in experiment 6) 2 cc. of 1% CuSO_4 were added. The mixture was tried for its effect on poisoned seeds. No activation was observed. In certain cases an inhibiting action was observed.

EXPERIMENT VIII.

THE INFLUENCE OF WATER USED AS A MEDIUM FOR THE ROOTING OF CUTTINGS ON THE GERMINATION AND ROOT-FORMING ABILITY OF POISONED SEEDS

Samples of water, which had contained *Nerium Oleander* (4 days), *Geranium sp.* (12 days), or *Justicia alba* (12 days) cuttings were tried for their effect on seeds poisoned by the method described in experiment 6.

Table 6.
(one of 2 experiments).

	Geranium Out of 150 seeds	N. Oleander Out of 150 seeds	Justicia alba Out of 100 seeds	Water control Out of 100 seeds	Time
Beginning	—	—	—	—	5.VIII
Number showing signs of germination	4	9	6	0	6.VIII
Number germinated	86	76	47	16	7.VIII
Number of roots	73	76	55	9	7.VIII
Number germinated	114	118	75	38	9.VIII
Number with roots longer than 0,5 cm	126	113	110	11	9.VIII

Note:— 7.VIII. In most cases the coleoptile was put forth before the radicle.

The experiment indicates that the substances present in the leaves and cuttings stimulate root formation in poisoned seeds. This substance (or substances) is water soluble and passes from stem or leaf cuttings into water by diffusion. (For photograph of this experiment taken on 8.VIII, see Plate V. Fig. 4. a—water control; b—watered with *Justicia's* water, c—watered with *Oleander's* water; d—watered with *Geranium's* water.

DISCUSSION

The experiments described deal with the nature of the CuSO_4 "poisoning" of seeds and its cancellation by the use of various plant extracts.

The poisoning effect of CuSO_4 solution is reversible and involves no irreparable damage to vital tissues. The CuSO_4 does however seem to cancel one or more factors essential to normal germination and growth. These factors may be replaced by various plant extracts. The fact that the poisoning is specific to root formation, whilst stem formation is hardly affected, suggests that different growth principles are involved in the formation of these two organs.

It is shown above that (a) macerates of different leaves and roots and (b) water which has served for the rooting of cuttings almost normalize the root forming ability and power of germination of poisoned seeds.

No proof of identity between the activating substances present in either leaves, roots, water which has served as a medium for the rooting of cuttings, or seeds is furnished. Such proof must depend on detailed future chemical study. Some evidence in this direction may, however, be adduced from the observed similarity in the physiological and chemical behaviour of the preparations. It is already clear, that the activating substances are soluble in water, are not species specific, and are not destroyed by boiling for 10 minutes.

The active substances in our extracts are not auxins.

The extracts did not fully restore the germination and root forming ability of the seeds. Possibly the CuSO_4 causes certain secondary unknown changes in the seeds. (The presence of CuSO_4 in the seeds is in itself some change from normal).

The question whether the same substance is responsible for the restoration of both root forming ability and germination power remains undecided. Press juice of potato increases the percentage germination, but does not appreciably influence root forming ability. On the other hand, in the case of the water samples, in which cuttings had been rooted, the power to restore root forming ability went hand in hand with the power to restore germination ability.

The effectiveness of the different preparations varied. The most efficient preparation was that of *Cynodon dactylon*. (It is interesting to note in this connection the extraordinary rooting ability of this plan in nature).

CONCLUSIONS

(1) Seeds of *Triticum durum* lose their root forming ability and are weakened in their power of germination when treated with 1—2% CuSO_4 solution.

(2) Extracts of various plants and water samples in which plant cuttings have been rooted, restore the root forming ability and germination power of poisoned seeds.

(3) The active substances present in the extracts are soluble in water, resistant to boiling for ten minutes, and non-species specific.

(4) The active substances are not auxins.

Note :— In a recent publication by WITSCH (1936), some interesting observations on the influence of copper on plagiotropic organs are reported, and interpreted to mean that copper influences the transport and production of growth substances. Perhaps a similar relationship governs the inhibiting action of copper upon germination. In view of our auxin experiment No. V, however, this seems to be improbable. Moreover, in another experiment we were able to show that addition of 3% CuSO_4 to a heteroauxin paste exerted no inhibiting effect upon the bending of *Avena* coleoptiles.

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LIFE—CYCLE OF THE RUST ON *ANCHUSA STRIGOSA* LABILL.

By HAYA CHABELSKA

In the vicinity of the Hebrew University of Jerusalem, many leaves of *Anchusa strigosa* Labill. display large and conspicuous rust spots during the winter: these are produced by the spermagonial and aecidial stage of a rust-fungus provisionally named *Aecidium asperifolii* Pers. The spermagonia and the aecidia appear in November, at first isolated on the cotyledons and on the young leaves. Later, however, they increase considerably, forming large blotches and producing a deformation of the leaf resembling a blister. The increased diameter of the diseased portion is caused by the action of the rust hypha which circulate between the cells of the host plant separating them and at the same time increasing their volume.

The optimal development of the aecidial stage occurs in February-March. Some day after the first hot winds ("hamsin") in March the aecidia disappear suddenly and can be found only on *Anchusa* leaves in shady places. In April-May even these disappear.

During the winter of 1937-1938 the *Aecidium asperifolii* on *Anchusa strigosa* was severely attacked by *Tuberculina persicina* Dietm. et Sacc.

In order to find out on which other host plants this Fungus develops its uredo- and teleutosori, we infected a series of gramineous plants growing in Palestine with its aecidiospores. The plants were: *Aegilops ovata* L., *Ae. variabilis* Eig., *Bromus alopecurus* Poir., *Bromus fasciculatus* Presl., *Cynosurus echinatus* L., *Hordeum sativum* Jess.; *Koeleria phleoides* (Vill.) Pers., *Phalaris nodosa* L., *Triticum durum* Desf.

The infections were applied either by depositing a great many aecidiospores on the leaves of these grasses, or by the method indicated by J. C. ARTHUR ("Plant rusts"):- i.e., numerous leaves of *Anchusa strigosa* bearing the aecidiospores were spread on a roof of wide-meshed tulle. Beneath this roof pots of the plants to be infected were placed so, that the aecidiospores dropped constantly on to the leaves underneath. The entire arrangement was enclosed under a bell-jar. Under another bell-jar were control plants, without aecidiospores.

Four weeks after the beginning of the experiment, we observed discoloured spots on the leaves of *Aegilops variabilis*. Two days later uredosori developed on these spots and after a week there appeared teleutosori. All the other plants infected and the control plants showed no sign of disease.

We checked the results of these experiments by plants growing naturally in the proximity of tufts of *Anchusa strigosa* in the University Garden—all the *Aegilops variabilis* were severely affected by rust.

The following year we repeated our infection experiments with different species of *Aegilops*, viz.: *Ae. variabilis* Eig (Palestine), *Ae. caudata* L. (Asia Minor), *Ae. triuncialis* Vis. (Syria), *Ae. columnaris* Zhuk. (Asia Minor), *Ae. ventricosa* Tausch. (North Africa).

Three weeks later three of four plants of *Ae. variabilis* were found to be severely affected by rust. Only one plant of *Ae. ventricosa* developed uredosori at the tip of a leaf. Out of four *Ae. columnaris* plants only one bore light yellow spots, which later developed into uredosori. Of three *Ae. triuncialis* plants only one bore dark-brown stains, but no uredospores. The four *Ae. caudata* plants were not affected at all. Three weeks later some uredospores were detected even on the two last mentioned species. The control plants showed no sign of infection.

Two months after the beginning of the experiment, the disease on *Ae. variabilis* had developed and spread to all the leaves and even to the sheaths. Among the uredosori appeared a great number of teleutosori. On all the other plants the affected leaves had become yellow and shrivelled, and dropped off leaving no trace of disease.

At the beginning of July 1937 we gathered a considerable quantity of *Ae. variabilis* plants bearing teleutospores in large numbers and placed them on a layer of soil in an open box, covered only with a fine wire netting. This box was placed on the roof of our house, so that the plants were exposed all summer to the variations of weather. During this period every attempt to induce germination of the teleutospores failed. On October 16, after the first rainfall, we obtained germination of the teleutospores for the first time, and on October 24 the percentage of germination was very high. We then applied the infection to numerous *Borraginaceae* with the teleutospores, by placing them directly on the surface of the leaves and maintaining them in position by the application of damp cotton wool. We experimented

with *Alcana strigosa* Boiss., *Anchusa hybrida* Ten., *Anchusa strigosa* Labill., *Cynoglossum creticum* Mill., *Echium angustifolium* Mill.

A month later aecidia appeared on the infected leaves of *Anchusa strigosa* only. All the other plants remained unaffected. Three days after the appearance of the artificially induced aecidia, the latter also made their appearance on non-artificially infected plants in the vicinity of the Hebrew University. This proves that natural infection occurred during the same period.

On consulting the literature available on the subject of heteroeccious rusts, we found mention in the paper of R. MAIRE (Bull. Soc. Bot. Fr., 1914) of his observation of *Puccinia Aegilopsis* Maire developing in Algeria its uredo- and teleutospores on *Aegilops ovata* and its aecidial stage on *Anchusa italica*. Professor R. MAIRE was kind enough to send us a specimen of *Puccinia Aegilopsis* (on *Aegilops ovata*), which we compared with our specimens and found them identical. We therefore gave the name of *Puccinia Aegilopsis* Maire to our species too, although the two Palestinian host plants differ from two Algerian host plants and are new host plants for rust in general. We must point out, however, that our *Puccinia Aegilopsis* belongs to a different physiological form, since it does not affect *Aegilops ovata* and we met no *Anchusa italica* affected by rust in the vicinity.

THE GERMINATION OF *VISCUM CRUCIATUM* SIEB.

By J. GLIMCHER

(With 2 diagrams in the text)

SUMMARY

In order to determine the conditions of germination of *Viscum cruciatum* Sieb., the seeds were fixed to wooden boards and were put under varying conditions of light, temperature and humidity. The sticky mesocarp of the fruit present beneath the red mesocarp serves as a good fixing medium. The viscous seeds contain sufficient water for germination (55 per cent of the fresh weight of the seed).

(1) The quickest germination was obtained outdoors in strong light and exposure to direct sunrays (during the entire day), at an

average temperature of 15°C (in a meteorological tent) and at a medium humidity of 70%. In this case, two weeks after the beginning of the experiment (8.XI.37) 35-40% germination was observed and after one month germination approximated 90%. At a lower temperature and weaker light over the lower surface of another wooden board, the germination proceeded at a much slower rate.

Below is a Table of the comparative germination of the seeds affixed to the upper and lower surfaces of one wooden board.

Date	Beginning of the experiment			
	8.XI.37	25.XI.	9.XII.	24.XII
Upper surface		35 %	85 %	96 %
Lower surface		0	32	71

Seeds containing one embryo germinate faster than those containing two or more embryos.

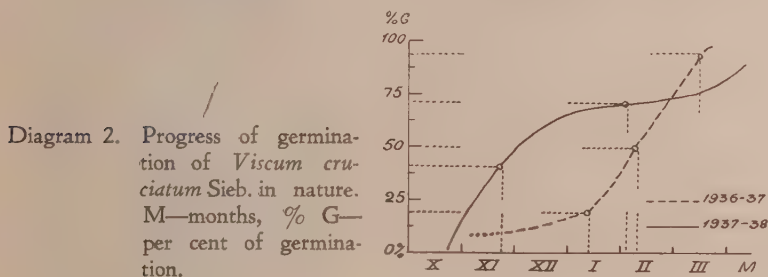
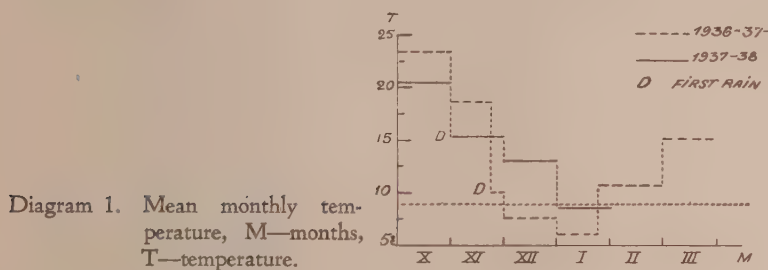
(2) Intensity of light: *Viscum cruciatum* Sieb. does not germinate in absolute darkness, nor in weak diffused light. Constant daily illumination by diffuse daylight with maximum intensity of 34 Bunsen-Roscoe units (after exposure for half an hour) is sufficient to furnish the necessary irritation for germination. Daily illumination with maximum intensity of 5 units — obtained during the same exposure — was insufficient. (The measurements were made by means of the Dauer-Graukeil Photometer, after Eder Hecht.). After having received the proper irritation, the seeds continue to germinate in the dark also.

(3) Minimum temperature: According to observations in nature, in a cold year within average temperature of $6-8^{\circ}\text{C}$ during the first winter months, germination almost stops. It appears that an average temperature of $8-10^{\circ}\text{C}$ is the minimum required for germination.

(4) Humidity: Seeds which already had received the proper irritation of light and temperature proceed to germinate also in an exsiccator of sulfuric acid. In saturated air and ordinary light the seeds rot before beginning to germinate.

(5) Inhibiting substances: Comparing the speed of germination of seeds from which the sticky mesocarp had been removed by washing and those with the mesocarp, it becomes clear that the slime has no inhibiting influence upon germination. On the contrary, in all cases the seeds with the slime germinated a bit more quickly than those without the slime.

(6) Germination capacity in nature: In order to determine the capacity of germination in nature on olive trees, corresponding counts were made during the past two years. It was shown that germination depends on the range of temperature following the dispersal of fruits (occurring at the beginning of the rainy season). Wide variations may take place in connection with this, from year to year. This may be seen clearly in the appended diagrams, 1 and 2.



THE J. MONTAGUE LAMPORT¹ MEMORIAL BOTANICAL GARDEN OF THE HEBREW UNIVERSITY

By A. EIG

The BOTANICAL GARDEN OF THE HEBREW UNIVERSITY was founded in 1931. It consists of two pieces of land. One, 31 dunams in area, is situated between the Rothschild Hadassah University Hospital and the University Buildings in a long and narrow strip on the summit of Mt. Scopus facing the Dead Sea. Edaphical and microclimatical conditions are very unfavourable for plantation. The soil is meagre and not deep and contains about 60-70% of CaCO_3 . "Nari" rocks are abundant. Violent cold and hot winds are common in winter and spring.

The second piece, about 22 dunams in area, is situated in front of the War Cemetery, some 250 m. N of the first. The soil is much more fertile and microclimatical conditions are more favourable.—The first piece is devoted chiefly to a phyto-geographical scheme, the second—chiefly to a systematical arboretum and to field experiments.

In the phytogeographical part the aim is to represent "the past and present" of the vegetation of Palestine. It is subdivided into three portions: Mediterranean, Irano-Turanian and Saharo-Sindian. The plantation of the first portion has been more or less completed. The *Pinus halepensis* — *Hypericum serpyllifolium* climax is represented by a series of plots beginning with the pure *Pinus halepensis* — *Hypericum serpyllifolium* forest and ending with its last degradation and its replacement by the Maqui. The continuation of this series consists of several types of Maqui and their degradation stage. Lastly, there are the different types of Batha, the last degradation stages of forests.

The second series is that of *Quercetum ithaburensis*, another important climax of Mediterranean Palestine. The third series is that of *Ceratonia Siliqua* — *Pistacia Lentiscus*-climax. A type of *Querce-*

¹ MONTAGUE LAMPORT, a young American Jew, was drowned while endeavouring to save others. His family acquired one of the two plots of the Botanical Garden and provided part of the funds for the planting and maintenance of the Garden.

tum infectorii is also represented. All the plots are planted as far as possible according to the composition of the natural stands. Some corrections in the composition of the plots are being introduced as the studies on Palestine phytosociology advance.

The plantation of the Irano-Turanian and Saharo-Sindian associations is still in preparation. Here we expect more difficulties than with the plantation of the Mediterranean plots. For the moment the work is concentrated in the Nursery where seedlings of principal Palestinian steppe and desert plants are being grown. Setting of these seedlings will begin at the end of this year.

The phytogeographical scheme includes a basin for marsh and water plants. Various plant associations are planted here at different depths. This basin is chiefly to represent the principal associations of Huleh marshes, the reclamation of which has already begun.

Besides the phytogeographical part of the garden, there are a number of miscellaneous plots. The most important of these is a group of about 200 *Cedrus Libani* trees. This tree does not belong to the wild Palestinian flora (its nearest stations are in the Lebanon), but it is well known from the ancient Hebrew literature. A part of the seedlings planted have been brought from the Lebanon forests. The remainder was grown from seeds obtained from the Lebanon. Some of the young trees are already 1 m. high, but their development in general is rather slow. No doubt in the future this grove will be one of the most beautiful in Jerusalem. Some small groves of other wild trees of Syria of economic and scientific interest (e.g. wild *Cupressus*, *Pinus Brutii* etc.) have been planted next to the *Cedrus Libani* plantation. A large collection of bulbous and cormous wild plants of Palestine and of the neighbouring countries which is being augmented from year to year is situated near the basin of water plants. About half a dunam is devoted to a collection of Palms and some other Monocotyledons. Another half a dunam is devoted to a series of plots of Palestinian *Labiatae*.

A hothouse is planned for plants which cannot be grown in the open air and are important for botanical courses. A rockery devoted chiefly to rocky plants of Palestine and of the Near East is planned also. Unfortunately funds are lacking for the moment for the realization of this plan.

The plantation of the second part of the garden, situated in front of the War Cemetery, was begun only this year. The principal por-

tion will be devoted to a systematical arboretum. In this arboretum chiefly Palestinian and Syrian trees and shrubs will be represented. Experiment field plots for Applied Botany occupy the major part of the rest of this second portion of the Botanical Garden.

The plantation of the Botanical Garden advanced rather slowly because of lack of funds. Owing to the extremely bad edaphical conditions of the major part of the garden we are compelled to expend annually a great part of the budget, which on the whole is very limited, for soil reclamation, that is, explosion of rocks, transportation of soil, terracing, etc. But seeing the results already obtained we are confident that we shall overcome the financial difficulties also.

"GAN SHLOMIT"—SHLOMIT GARDEN¹

By A. EIG.

(With Plate VI)

One of the most striking features of Palestine is the complete denudation of verdure during the hot and long summer in the major part of the country. This is true especially of the neighbourhood of larger cities, Jerusalem in particular. We already know, however, that practically the whole Mediterranean territories of Palestine were once covered by high forests or their derivatives, garigues and maquis. But this tree and shrub vegetation has been destroyed in the course of the long history of Palestine, and likewise the very soil that supported this forest and shrub associations. Now in most cases only Batha and the therophyte associations are visible during the rainy season.

The contrast of the glorious past and desolate present induced Mrs. V. SALOMONS, an English Jewess greatly devoted to the ideal of the New Palestine, to devote 1934 a hill of about 30 dunams adjacent to the University ground to the restoration of the natural vegetation of Palestine, in particular of the Mountains of Judea. There is a magnificent view of the Dead Sea and the Jordan Valley from the top of this hill.

The plan of GAN SHLOMIT coincides, in general lines, with the phytogeographical part of the University Botanical Garden. A great part of the Garden is therefore devoted to the *Pinus halepensis*—*Hypericum serpyllifolium* climax, which predominates also in the environs of Jerusalem. This climax is represented chiefly by two plots. One of them represents *Pinus halepensis*—*Hypericum serpyllifolium* forest in its more or less intact stage; the second—a stage of advanced destruction by man, as it is still encountered in Transjordan and here and there in Cisjordan. These plots are continued by a type of forest differing from the former chiefly by its edificator—*Pinus Brutii* (instead of *Pinus halepensis*). This kind of forest is common in Syria.

¹ "Gan Shlomit" — Shlomit Garden is a private one of scientific value, planned and administered by the Author.

Two types of *Quercetum ithaburensae* represent a second important climax association of Palestine. A rather large plot represents the third important climax of Palestine, *Ceratonia siliqua*—*Pistacia Lentiscus* forest. A series of plots of *Quercus calliprinos*—*Pistacia palaestina* association occupy 1, 2 dunams. This low tree-shrub association is very important in some districts of Palestine even at present. A series of plots representing different types of Batha associations show the predominant recent vegetation of Palestine. These are the most important parts of the Garden.

A 2 dunam plot is devoted to cultivated plants mentioned in the Bible and the later ancient Hebrew literature. This is intended to complete the picture of the ancient vegetation of Palestine. A small grove of *Cedrus Libani*, well known from the Hebrew literature but not indigenous in Palestine, is planted in the edaphically and microclimatically best part of the Garden. Many plots of Palestinian perennial *Labiatae* are planted both for their beauty and scent and for the purpose of study from the industrial point of view. A two-dunam reservation is left to represent the natural vegetation of the ground as it was before we started planting. This is a type of *Ononis natrix*—*Noea mucronata* association.

The GAN SHLOMIT is situated only half a kilometer E of the Botanical Garden, but the microclimatical (and to a certain degree the edaphical) conditions here are still less favourable for the Mediterranean vegetation. It is therefore not only from the purely scientific, but also from the practical (forestry) point of view that the GAN SHLOMIT is of great interest. The possibility of taking root and the rate of development of many scores of Mediterranean trees and shrubs may be studied here in extreme conditions.

But the chief purpose of the Garden is a "botanico-archaeological" one, to restore the natural vegetation of the country of those remote times when the Mediterranean part of the country was thickly covered by forests and our forefathers, in order to settle, there they had to cut down a part of the woods. "If thou be a great people then get thee up to the wood country and cut down for thyself... Thou art a great people and hast great power. Thou shalt not have one lot only, but the mountain shall be thine; for it is a wood, and thou shalt cut it down" (Joshua, XVII: 17, 18).

GERSHON MOSHEOV — IN MEMORIAM

1913—1936

GERSHON MOSHEOV, the author of the two papers which are here published, was seriously wounded, while on guard-duty at Kiriath Anavim, a Jewish agricultural holding near Jerusalem, during a firing attack by Arabs on August 17th, 1936. After 3 days of great sufferings, he died, being then 23 years of age.

Gershon Mosheov was born in Jerusalem in 1913. He was enrolled as a student of Biology in the Hebrew University at Jerusalem in 1932, after having completed his matriculation and graduated from the Hebrew Teachers College at this city. His unusual ability, perception, and diligence already marked him out from among his fellows in his second year of studies at the Plant Physiological Laboratory. His interest heightened with every additional laboratory, and soon he had decided to specialize in the field. His first attempt at independent investigation,—on the influence of salts in germination,—indicated that the first impression received from him had not been misleading. From day to day, his diligence and enthusiasm grew. It was not difficult to foresee that from this young man an adept searcher in the field of Plant Physiology would develop.

As a teacher, too, Mosheov was talented. He proved his ability in this direction when, beginning from the winter semester of 1935/36, he filled the position of assistant instructor in my laboratory.

As early as 1935, he published his first scientific paper in the Hebrew Journal "Hatteva' Vehaaretz", Vol. IV, on the subject of growth substances. This paper constitutes a review of the state of the research at the time. The work which was originally delivered as a seminary discourse and was noted down and published at my suggestion, is a clear indication of his abilities. Simplicity, lucidity, and precision in expression, are its outstanding characteristics. All the problems are reduced to their simplest formulae. But above all, this paper shows the marked independence of his thinking. He showed himself able to bring uniformity and order into the numerous experimental results in the field and added his own fruitful criticism at many points.

The admirable features of the young researcher Mosheov are even more truly characteristic of the man Mosheov. He gave the rare impression of a self-contained personality, an impression which was all

the more astounding in view of his youth. In him all was clear, consistent and determined. His personality had a powerful attraction, and soon we were no longer teacher and pupil, but friends. This attraction was sustained on the one hand by the clarity and integrity of his personality, and on the other hand by the great purity which radiated from him. During all the time of our association — in the laboratory and in field excursions (for the last time, at the big excursion to the Transjordan desert, the Red Sea, and Sinai) — I never once observed word or deed in him which was not borne by a profound sense of responsibility.

The two papers by Mosheov which are here published were at the time of his death not yet fully completed. We have prepared them for print without many changes. At several points therefore, it will be evident that the work was not completed, and that the author still intended to repeat and extend several of the experiments in various directions. Nevertheless we have published them, since even in their present form, they constitute a valuable contribution to the problems they discuss.

M. EVENARI (W. SCHWARZ)



"Gan Shlomit" — General View from Department of Botany

EIG — "GAN SHLOMIT"

לזכרו של גרשון מושיוב

גרשון מושיוב נפצע פצעי מות בליל 17 באבגוסט 1936, בהגנו על קרית ענבים, בשעת התקפה של פורעים ערבים. אחרי שלושה ימים של ענוים קשים יצאה נשמתו, בהיותו בן 23.

נולד בשנת 1913 בירושלים. בשנת 1932 הוא נרשם בתור תלמיד למדעי הטבע של האוניברסיטה העברית. אחרי גמרו את למודיו בגמנסיה ובית המדרש למורים בירושלים. בשנה השניה ללמודיו הוא בולט מאוד במעבדה לפיסיולוגיה של הצמח על ידי כשרונותיו המצויינים, חריצותו ותפיסתו המהירה. התענינותו במקצוע זה הולכת וגדלה מיום ליום והוא מחליט להתמסר לפיסיולוגיה של הצמח.

עבודתו העצמאית הראשונה, שטפלה בהשפעת המלחים על הנביטה הוכיחה, שהרושם הראשון שהוא עשה עלי במעבדה לא היה רושם מוטעה. התלהבותו התעמקותו ודבקותו במקצוע גדלים והולכים מידי יום ביומו, ולא קשה היה לקבוע שעלם זה יצמח לחוקר מוכשר בשדה הפיסיולוגיה של הצמח.

כוחו של מושיוב היה גדול גם בשדה ההוראה. הדבר הזה התגלה ביחוד כשעזר לי בהוראה, בתור אסיסטנט, בסמסטר החורף של שנת תרצ"ו.

את מאמרו המדעי הראשון על "חמרי צמיחה" הוא מפרסם ב"הטבע והארץ", כרך ד'. במאמר זה הוא נותן סקירה על מצב ידיעותינו בפויבלימה זו בזמן הזה. המאמר הזה, המצטיין בפשטותו, בבהירות ההבנה ובסגנונו המדויק והשוטף, מוכיח כבר בעליל את גדלו של מחברו וראשית כל את העצמאות שבמחשבתו. הוא מצליח לסדר את העבודות השונות והמרוכבות הידועות בענף זה לשיטה אחת ומוסיף במקום זה או אחר את בקרתו העצמאית.

מענינת מאוד היא גם אישיותו של מושיוב. היתה זו אישיות מושלמת בתכלית השלמות, דבר הנדיר מאוד בגיל זה. אישיותו הקסימה את כל אחד שבא במגע ישר אתו והיא גם גרמה לידי כך, שהיחס בינינו היה יחס של ידידות. הקסם הזה נגרם מצד אחד על ידי בהירות נפשו ובטחונה ומאידך גיסא על ידי פשטותה ותמימותה.

שתי העבודות של מושיוב שנתפרסמו בחוברת זו לא היו מושלמות עדיין בזמן פטירתו. למרות זה החלטנו לפרסמן מבלי שנויים רבים, כיון שגם במצבן זה, הן מצעידות אותנו צעד ענקי קדימה בהבנת הפרובלימות הנידונות ופתרונן.

מ. אבן-ארי (ו. שורץ)

הגן הבוטני על שם יוסף מונטגיו למפורט¹

מאת א. איג

הגן נוסד ב־1931. הוא משתרע על פני 2 חלקות, אחת בין בית החולים של „הדסה“ ע"ש רוטשילד ובנייני האוניברסיטה והשניה מול בית הקברות הצבאי. החלקה הראשונה מוקדשת בעיקר לחלק הפיטוגיאוגרפי של הגן. הוא צריך בעיקר לייצג את העבר ואת ההווה של הצומח הארץ־ישראלי. בהתאם לחבלים הפיטוגיאוגרפיים השונים של הארץ הוא יכיל את הצומח היס־התיכוני, האירנור־טורני והסהרר־סינדי. לעת עתה הולכת ונגמרת הנטיעה של החברות היס־תיכוניות. השנה מתחילים בנטיעות של הצומח האירנור־טורני והסהרר־סינדי. נבנתה ברכה בשביל צמחי מים, בעיקר מחולה. חורשות של ארז הלבנון, ברוש בר וכו', כמו גם אספי חברות צמחי פקעת ובצל מהארץ והארצות הסמוכות קשורים עם החלק הפיטוגיאוגרפי של הגן. החלקה שמול בית הקברות הצבאי מוקדשת לארבורטום סיסטמטי ולשדות נסיון. הנטיעה מתחילה שם השנה. התקדמותו של הגן הבוטני היא אטית מאוד הן מפני התנאים האקולוגיים הקשים והן מפני חוסר אמצעים במידה מספיקה.

„גן שלומית“

מאת א. איג

גן שלומית נוסד ב־1935 על שטח בן 30 דונמים בערך. הוא קנינה של הגב' שלומונס, יהודיה מאנגליה, אשר התקשרה קשר אמיץ עם מפעל תחית הארץ. תכנית הגן היא „בוטנית־ארכיאולוגית“, ומטרתו לנסות לייצג בו את הצומח ששלט בא"י, ביחוד בהרי יהודה, בזמן כיבושם של עולי מצרים ובתקופת התנ"ך. מובן, לכן, שגן שלומית מתאים בקיום כלליים לחלק הפיטוגיאוגרפי של הגן הבוטני של האוניברסיטה. חוץ מהקלימכסים היס־תיכוניים העיקריים ומדרגות הדגנרציה שלהם, מכיל הגן חורשה של ארז הלבנון והרבה חלקות של Labiatae שונים מארץ־ישראל.

¹ י. מ. למפורט היה יהודי אמריקאי צעיר שטבע ומת בעת הצילו טובעים אחרים. משפחתו רכשה חלקה אחת מהשתים של הגן הבוטני ותרמה גם את חלק ההוצאות שהוצאו לנטיעתו ולקיומו של הגן.

1. הנביטה המהירה ביותר נעשתה לאור קרני השמש הישירות בטמפרטורה ממוצעת של 15 מעלות צ' ולחות בינונית של 70 אחוז. בתנאים אלה נתקבלה נביטה של 35-40% שבועיים אחרי תחילת הנסיון וקרוב ל-90% כעבור חודש אחד.
2. בתנאי הארה וטמפרטורה נמוכים יותר היתה הנביטה איטית הרבה יותר.
3. פרות שהכילו זרע אחד מהרו לנבוט מאלה שהכילו שנים ויותר.
4. אור דיפוזי במרחק מטר אחד מחלון צפוני (בצהרים נתקבלו 34 יחידות ביונן באקספוזיציה של חצי שעה לפי הפוטומטר של Eder Hecht) הספיק לעורר את הגרוי הדרוש לנביטה.
5. טמפרטורה ממוצעת של 8-10 מעלות צ' היא המינימום הדרוש לנביטה על גבי עצי הזית בטבע.
6. על יסוד השוואה מתברר כי אין כל חמרי עכוב בריר המקיף את הזרע.
7. לפי הספירות על גבי עצי הזית התברר כי הנביטה שונה משנה לשנה והיא תלויה בחלוקת הטמפרטורה של העונה, הבאה לאחר תפוצת הפרות, כפי שזה נראה בדיאגרמה.

העכוב בנביטה וביצירת השרשים הנגרם על ידי הטפול בגפרת-נחושת ובטולו של עכוב זה

מאת גרשון מושיוב

בנסיונות על חמרים מעכבים התברר ששיטת הסטריליזציה של הזרעים בעזרת גפרת נחושת בן 1-2% נותנת תוצאות רצויות. אבל על ידי הטפול הזה נגרמת החלשה בנביטה בכלל וביצירת השרשים בפרט.

לגרגירים של חטה קשה, שהפסידו את כוח יצירת השרשים על ידי הרעלה בגפרת נחושת מסוגלים לחדש כוח זה אחרי שמשרים אותם במהלם של צמחים שונים או במים, שגדלו בהם יחורים. על ידי פעולת גפרת הנחושת מפסידים, כנראה, הגרגירים את החמרים הפעילים ביצירת השרשים והם מוחזרים לגרגירים על ידי הוספת מהלי הצמחים. החמרים הפעילים פה אינם מזדהים עם אוכסין. הם נמסים במים, ואינם נהרסים על ידי הרתחה במשך 10 רגעים.

מחזור ההתפתחות של החלדון על ANCHUSA STRIGOSA

מאת חיה חבלסקה

הוכח על ידי נסיונות מתאימים והסתכלויות בטבע ש-*Acidium asperifolii* החי על *Anchusa strigosa* שייך למחזור ההתפתחות של צורה ביולוגית אחת אשר ל-*Puccinia Aegilopsis* Maire, המפתח את נבגי הבכורה (*Uredosporae*) והנבגים האפילים (*Teleutosporae*) שלו על *Aegilops variabilis* Eig. נבגי הכוסית (*Aecidiosporae*) שנלקחו מעל *Anchusa strigosa* עוררו אמנם מחלה באופן חלקי גם אצל מיני *Aegilops* אחרים, אולם המקרה הטפוסי של הופעת המחלה היה רק אצל *Aegilops variabilis*. הנבגים האפילים שנלקחו מעל *Aegilops variabilis* עוררו את המחלה אצל *Anchusa strigosa* אבל נסיונות ההדבקה שנעשו עם מינים אחרים של משפחת הזיפניים (*Borraginaceae*) לא הצליחו.

הנביטה של דבקון הזית (VISCUM CRUCIATUM SIEB.)

מאת י. גלימצ'ר

הזרעים של דבקון הזית הודבקו באמצעות המזוקרפ הדביק, המקיף את הזרע על לוחות עץ מתאימים והושמו בתנאים שונים של הארה, לחות וטמפרטורה.

STIGMATELLA — סוג חדש ממשפחת CRUCIFERAE

מאת א. איג

נתן תאור של סוג חדש, *Stigmatella*, בן מין אחד *S. longistyla* Eig ממשפחת *Cruciferae*, הגדל בקרקע חול בין עמון ועקבה. הסוג החדש קרוב לסוג *Maresia*.

MOSHEOVIA — סוג חדש ממשפחת SCROPHULARIACEAE

מאת א. איג

נתן תאור של סוג חדש, *Mosheovia*, בן מין אחד *M. galilaea* Eig מהגליל העליון. הסוג החדש קרוב לסוג *Scrophularia*. הוא מוקדש לזכרו של גרשון מושיוב, תלמיד יעוזר של המחלקה הבוטנית, שנפל חלל בהגנה על קרית ענבים ב־1936.

השפעת המשרה של גרגירי חטה על הנביטה והגדול

מאת גרשון מושיוב¹

אופנהימר הוכיח, שבפרות עסיסיים יש חמרים המעכבים את הנביטה. חוץ מהחמרים הללו הנמצאים בציפת הפרי או בקלפתו ישנם חמרי עכוב בקלפת הזרע או בזרע עצמו. הנסיונות נעשו בחמרים מעכבים, הנמצאים בתוך החלקים החצוניים שבגרגירי החטה.

הוכח: (1) שהחלקים החצוניים של גרגירי חטה מכילים חומר המעכב בעד ההתעוררות;

(2) חומר זה הוא טרמולבילי ונהרס על ידי הרתחה ממושכת;

(3) פעולת העכוב של החומר הנ"ל היא יותר אינטנסיבית באור מאשר

בחושך;

(4) נתברר שהמשרה (לאמר המים שבהם היו שרויים גרגירי החטה) מכילה גם חומר, הגורם לאחר זמן (3-4 ימים) לזרוז. אין לחשוב שהחומר הזה זהה עם החומר הקודם. השקאה במי ההשריה הללו מראה הבדלים בולטים בגודל הצמחים בהשוואה אל צמחים שהשקום במים;

(5) החומר המזוז הוא חומר טרמוסטבילי, הנמצא בפזוור קולודיאלי. השפעתו מסתברת בעקר כחומר מזון. אולם עוד טרם נעשו הנסיונות הסופיים בנידון זה.

¹ גרשון מושיוב, מחברו של המאמר הזה והבא אחריו, נפצע פצעי מות בליל 17 באוגוסט 1936, בהגנו על קרית ענבים, בשעת התקפה של פורעים ערבים. אחרי שלושה ימים של עניים קשים יצאה נשמתו, בהיותו בן 23. ציון על אישיותו נתן בסוף חוברת זאת.

6. במינים הפוליפלואידיים נמצאו הבדלים בגודל של כרומוזומים של אותו הטפוס. מלבד זה אפשר היה ממספרי הגרעינונים (הקשורים כפי שהוכח בשנים האחרונות בכרומוזומים בעלי הסטליטים) להסיק שכרומוזומים מטפוס ידוע נבדלים גם במובן נוכחות הסטליטים. מכאן שהגנומים השונים של המינים הפוליפלואידיים אינם הומולוגיים, ז.א. שהמינים האלה הם אלופוליפלואידיים.

חקירות בעדשי ארץ-ישראל II

זני העדשה התרבותית LENS ESCULENTA MOENCH.

בארץ-ישראל

מאת ד. ו. זיצ'ק

15 זנים של עדשים היו ידועים עד כה בארץ-ישראל. המחקר הזה העלה את מספר הזנים בארץ ל-42. מ-27 הזנים הנוספים 18 הם חדשים למדע, 9—לארץ. מ-77 הזנים הידועים עתה בעולם נמצאים, איפוא, בארץ יותר מהחצי. נתנת כאן טבלא המראה את סדור הזנים בקבוצותיהם הסיסטמטיות. כמו כן נתן מגדיר הזנים המצויים בארץ.

מבחן קריטי של המינים האורינוטליים של הסוג PICRIS (ובכללו גם HAGIOSERIS) של עשבית האוניברסיטה העברית

מאת א. איג

אין זכות קיום לסוג Hagioseris Boiss. האנדמי בארץ. יש להכלילו לתוך הסוג Picris ואין אפילו ליצור בשבילו סקציה מיוחדת בתוך הסוג האחרון הזה. שני מיני ה־ Hagioseris צריכים להקרא, איפוא, בשם Picris galilaea (Boiss.) Benth. et Hook ו־P. amalecitana (Boiss.) Eig.

האנליזה המורפולוגית ההשוואתית של מיני Picris אחרים מהארץ מוכיחה שלמרות דמיונם המורפולוגי הנם נבדלים יפה במובן אקולוגי וגיאוגרפי. נתון תאור של מין חדש של Picris (P. intermedia Eig), אנדמי לארץ, שמרכז תפוצתו הוא בטריטוריה האירנו־טורנית של מדבר יהודה. כמו כן נתנים תאורים של מספר וריאנטים חדשים למינים שונים של הסוג Picris. לבסוף מובא, נוסף על תפוצתם של מיני ה־Picris שבעשבית האוניברסיטה העברית, גם מפתח אנליטי למינים של הסוג הזה מארץ-ישראל וסוריה.

כי אם בחלקם התחתון של טרפיהם. חלק זה של הטרף מהווה כאן כעין עוקץ, החודר אל תוך האדמה והנושא בקצהו את בצלצול הרבוי, כשהוא עטוף בחלקו הנדני של העלה.

ג) אצל *G. dubia*, *G. damascena* ו- *G. circinata* נמצאו בצלצולי רבוי במספר רבים, הערוכים כעין קרקפת על גבעולו הקצר של הצמח.
ד) אצל *Allium Ampeloprasum* נוצרים 2 מיני בצלצולי רבוי: א) בצלצולים הנשאים על עוקץ דק וקצר; ב) בצלצולים הנשאים על עוקץ עבה וארוך החודרים אל תוך האדמה והמסייעים בהסדרת העומק הנורמלי של הבצל באדמה.

מחקר מונוגרפי של הסוג BELLEVALIA (קריולוגיה, טכסונומיה, פילוגיניה)

מאת נעמי פינברון

במשך 10 השנים האחרונות נעשו מחקרים שונים, שמטרתם היתה לגלות את מהותם ואת ערכם היחסי של תהליכי האבולוציה הממשיים הקשורים בהתפתחותן של קבוצות סיסטמטיות שונות של צמחים (משפחות, שבטים, סוגים). דרך מחקרים אלה היא סינטטית ומיוסדת על שילוב הנתונים של המורפולוגיה המשווה, הפיטוגיאוגרפיה, הקריולוגיה והגנטיקה, המאפשר את הבנתם של היחסים הפילוגנטיים של המינים הנידונים ושל השינויים הגנטיים שחלו במשך התפתחותם הפילוגנטית.

במחקר זה על הסוג *Bellevalia* נסינו ללכת באותה הדרך. העבודה כוללת חלק קריולוגי, חלק טכסונומי-גיאוגרפי ומסתיימת בברור הפילוגיניה של הסוג.

סיכום החלק הקריולוגי

1. המינים של *Bellevalia* הם חומר נוח ללימוד המורפולוגיה של הכרומוזומים ושל שינויי הכרומוזומים במשך המיטוזה.
2. מספר הגרעינונים במיני *Bellevalia* הוא גבוה (4-6); על ידי פרגמנטציה הוא מגיע ל-12-7.
3. עד כה נבדקו מספרי כרומוזומים של 16 מינים של *Bellevalia*. 8 מהם נבדקו כאן לראשונה. המספר היסודי (\times) הוא 4. נמצאו 4 מינים פוליפלואידיים בעלי $2n=16$ ו- $2n=24$.
4. ארבעה טפסי כרומוזומים הנבדלים בצורתם אשר תוארו כבר לפני כן במיני הסוג *Bellevalia* נמצאו בכל המינים שנבדקו. הם מסומנים באותיות P, Q, R, S. במינים אחרים ישנם כרומוזומים בעלי סטליטים.
5. ניתנים תאורים של האידיוגרמות של 9 מן המינים שנבדקו.

כדי שהאופסין יביא תועלת בשימוש המעשי יש לקחת בחשבון את העקרונות הבאים:

א) אין מנה של אופסין קבועה ושטת הספקה קבועה וכללית, שאפשר יהיה להשתמש בה בכל מקרה ומקרה. בשביל כל מין ואפילו בשביל כל זן וזן של אותו המין יש לנסות ולמצוא את הכמות האופטימלית של האופסין הדרושה ואת אופן הספקתו הרצוי.

ב) יש להקפיד במיוחד בבחירת מנה כזו של אופסין, שלא תגרם אלא לעכוב קטן בלבולב הנצנים אבל תביא עוד לזרוז גדול ביצירת השרשים. מנקודת ראות זו נדמה לנו, שיש לבכר ברוב המקרים את ההספקה הבסיסית. למרות שהזרוז ליצירת השרשים בטפול זה אינו מפיסמלי, יש בכל זאת להציעו, היות והוא אינו גורם לעכוב בלבולב ה"עינים". כדי למנוע ככל האפשר את העכוב בלבולב ה"עין" של הרוכב בהרכבות, המופיע לרוב בטפול באופסין, מיעצים אנו, להתקין רוכבים גדולים יותר מאלה הרגילים כעת בשימוש, מכיון שהתברר במהלך הנסיונות, כי במדה שגדל המרחק שבין מקום ההספקה והקצה האפיקלי של היחור בה במדה העכוב בהספקה בסיסית קטן יותר.

לבסוף יש לציין, שהנסיונות האלה מאשרים את הדעה, כי במקרים ידועים אי אפשר בעזרת אופסין להביא בכלל צמחים לידי השרשה, אם הללו אינם נוטים להשתרש מטבעם (בלי טפול באופסין). אולם גם במקרים כאלה מגביר האופסין את יצירת הקלוס.

אצות של המעינות החמים בצרת השחר (קלירוהי)

מאת פ. פרמי (סן-ליו) וט. רייס (ירושלים)

בעבודה זו נתן מחקר על אצות שנאספו במעינות החמים בצרת השחר (Kallirrhoe) בארבעה מקומות שונים. הטמפרטורה של המים במקומות השונים היתה בין 35 ל-40 מעלות. נחקרו 17 מינים של כחוליות (Cyanophyceae) מהצד הסיסטמטי, ומהחשובות שבהן נתנו גם ציורים.

להכרת ההתרבות הבגטטיבית אצל הגיאופיטים של המזרח הקרוב

מאת מ. זהרי

א) אצל *Colchicum Steveni* נמצאה התפתחות של פקעות רבוי בחלק של הפקעת אשר ממול לנצן ההתחדשות. פקעות אלו נוצרות על פי רוב במספר רבים כל עוד לא הגיע הצמח לסטדיום של פריחה, ובמספר יחיד — משהגיע הצמח לגיל הפריחה.

ב) אצל *Gagea reticulata* נוצרים בצלצולי רבוי, הנשאים בחיקם של נדני העלים האקסוריים. עלים אלה אינם מעורים בציר הבצל באמצעות בסיסהם,

על החלוקה הפיטוגיאוגרפית של ארץ ישראל

מאת א. איג

ב־1931 נתפרסמה ע"י המחבר מפה פיטוגיאוגרפית ראשונה של א"י. בעבודה זו נתנה מפה מתוקנת, המיוסדת בעיקר על חקירות פיטוסוציולוגיות, בו בזמן שהמפה של 1931 היתה מיוסדת בעיקר על חקירות פלוריסטיות. החקירות הפלוריסטיות, הפיטוסוציולוגיות והפיטוגיאוגרפיות בארץ ששימשו בסיס למפה הנוכחית קשורות באופן צר אחת לשניה ועוזרות אחת לשניה.

צוינו חברות הצמחים העיקריות שבטריטוריות היס־תיכונית, האירנו־טורנית והסהרו־סינדית וחברות ה"גבול" שבין הטריטוריות האלו. הקלימכסים העיקריים בטריטוריות היס־תיכוניות הם קלימכסי יערות של *Quercus ithaburensis*, של *Pinus halepensis* — *Hypericum serpyllifolium*, של *Ceratonia siliqua* — *Pistacia lentiscus* ושל *Quercus calliprinos* — *Crataegus Azarolus*. יתכן שהיה קיים גם בשטח מצומצם מאוד יער של *Quercus infectoriae*. בטריטוריות האירנו־טורניות חשובות הן בריתות החברות של *Retamo-Phlomis brachyodontis*, *Noeion mucronata* ושל *Artemision Herbae albae*.

צוינה כאן מציאותן של שלוש טריטוריות אירנו־טורניות של הארץ. כמו כן נתנו תאורים קצרים של 4 טריטוריות סהרו־סינדיות עם החברות העיקריות של הבריתות: *Chenoleion arabicae*, *Salsolion tetrandrae*, *Acacion palaestinae* ושל החברה *Zygophylletum dumosi*. לבסוף נתנו כאן הערות פיטוגיאוגרפיות אחדות: בראשונה מודגשת שוב פעם ההכרחיות לדייק בהבחנת האזורים היס־תיכוני, האירנו־טורני והסהרו־סינדי. המונח "האזור היס־תיכוני הקדום" של פופוב (Popov) צריך להצטמצם בתחום הגיאוגרפיה ההיסטורית ומוטב היה במקום מונח זה, העלול להביא לידי בלבול מושגים, להשתמש במונח "אזור הטטיס". בהערה השניה נתנה הזהרה, כי בחקירות פיטוגיאוגרפיות אין לתת ערך מכריע לנוסחאות פיטוגיאוגרפיות שונות. בהערה השלישית מציין המחבר, שבחקירותיו הפיטוסוציולוגיות הוא הלך אמנם בעקבותיה של האסכולה של בראון בלנק (Braun Blanquet) אבל הוא סבור שלא היה מקבל תוצאות פיטוגיאוגרפיות שונות הרבה, לו היה משתמש במיתודה של אסכולה פיטוסוציולוגית אחרת.

השמוש בחמרי צמיחה להשרשת צמחים והשבחתם

מאת מ. אבן־ארי וא. קוניס

העבודה הזו מוכיחה בעליל את החשיבות הרבה שיש לאופסין — במקרים ידועים — בשמוש המעשי בגננות. הדבר הזה בולט פה ביחוד בפעולת הזרוז של השרשת התאנה והגפן וכמו כן בהשבחת הגפן בשטה האנגלית.

בתוך A. Engler, Die natuerlichen Pflanzenfamilien (1894-96). — Monographie der Myristicaceen (1897). — Die Muskatnuss (1897). — Pandanaceae בתוך A. Engler, Das Pflanzenreich (1900). — Monsunia I (1900). — Die Kautschukpflanzen und ihre Kultur (1900). — Die Kulturpflanzen der Weltwirtschaft (1907). — Die Pflanzenwelt I-III (1913-1922). — ורבורג היה גם עורכו של Der Tropenpflanzer במשך השנים 1897-1920, ושל Altneuland (1904-06).

ורבורג היה מנהיג ציוני ומייסד מפעלים התישבותיים מרובים בארץ: מ־1905 היה חבר ההנהלה הציונית, בשנים 1911-1920 היה נשיא ההסתדרות הציונית העולמית.

לכבודו הוקדשו הסוגים: Warburgia Engl. (Winteranaceae). — Warburgiella C. Muell. (Musci), Warburgina Eig (Rubiaceae). — הוא היה נשיא הכבוד של החברה הבוטנית של ארץ־ישראל. — בשמו קשורים: „יער ורבורג“ של Pinus halepensis באוניברסיטה העברית; „גן ורבורג“ לאקלום צמחים ופרות טרופיים וסובטרופיים ברחבות; „שדה ורבורג“, מושב יהודי גרמניה; ובשמו יקראו: „המוזיאון והספריה ע"ש ורבורג“ באוניברסיטה העברית; „הגן הבוטני ע"ש ורבורג“ במקוה־ישראל ו„כנר ורבורג“ בתל־אביב.

אוטו רברורג

1859—1938

הגנו מקדישים את הכרך הראשון של עתונינו לזכרו של פרופ' אוטו רברורג המנוח, מיסד המכון לחקירת טבע ארץ-ישראל של האוניברסיטה העברית, שנפטר ב־10 בינואר 1938.

ציון מלא על אישיותו המדעית של רברורג יופיע בסדרת רחבות של עתונינו ורשימה מלאה של כתבי המנוח תופיע בהוצאה מאוחרת של עתון זה בצירוף רשימת הצמחים שנתגלו וכונו על ידו. כאן נציין רק תאריכים חשובים אחדים של חייו.

ורברורג נולד ב־20 ביולי 1859 בהמבורג, למד באוניברסיטאות בון, ברלין, המבורג (במעבדה הממשלתית לכימיה). ב־1883 קבל את הדוקטורט לפילוסופיה באוניברסיטה של שטרסבורג (אצל דה־ברי, De Bary). ב־1883/84 עבד באוניברסיטה של מינכן (כימיה אצל באיר, Bayer) ואחרי זה באוניברסיטת טיבינגן (אצל פפפר, Pfeffer). ב־1891 הועלה לפריבטדוצנט באוניברסיטה של ברלין; ב־1894 התחיל לכהן כמרצה בסמינריון למדעי המזרח וב־1898 נתמנה בתור פרופסור. — בשנת 1921 נתמנה למנהל התחנה לחקר החקלאות של ההסתדרות הציונית בארץ-ישראל ומ־1925 היה הפרופסור לבוטניקה ומנהל המכון לחקירת טבע ארץ-ישראל שעל יד האוניברסיטה העברית.

מסע־מחקר בוטני חשוב נעשה על ידו בשנים 1885–1889 אל דרום־מזרח של אסיה וקבוצות האיים אשר שם. — עניניו המדעיים העיקריים היו: (א) טכסור נומיה של משפחות צמחים טרופיים, Myristicaceae, Pandanaceae, Begoniaceae, Balsaminaceae, Moraceae וביחוד הסוג Ficus. (ב) גיאוגרפיה של הצמחים (אזור מונסון, פפואזיה, בעיות נומנקלטורה; ג) תולדות צמחי תרבות, חקלאות והתישבות טרופית במושבות גרמניה; ד) בוטניקה שמושית וחקלאות בארץ-ישראל (אינטרודוקציה של גדולים חדשים. צמחים טכניים וכו'). — מתוך פרסומיו העיקריים נציין כאן: Beitrage zur Kenntnis der papuanischen Flora (1891). — Bixaceae, Winteraceae, Sabiaceae, Balsaminaceae, Flacourtiaceae, Begoniaceae, Datisceae

עתון לבוטניקה

סיון תרצ"ח

סדרת ירושלים

כרך א' חוב' א'

ה"עתון לבוטניקה" מופיע בשתי סדרות: סדרת רחבות וסדרת ירושלים.

סדרת רחבות היא המשכן של "רשימות לבוטניקה ולמדעי הגננות", שנוסדו ע"י ה. ר. אופנהיימר בשנת 1935. סדרה זו יוצאת לאור ע"י ה. ר. אופנהיימר וי. ריכרט מהתחנה לחקר החקלאות שברחבות ומהווה בטאון לבוטניקה טהורה ושימושית. שתי חוברות תופענה בשנה.

סדרת ירושלים יוצאת לאור ע"י חבר העובדים של המחלקה לבוטניקה באוניברסיטה העברית (המנהל: ד"ר א. איג). סדרה זו נועדה במיוחד לשמש בטאון למחקרים בוטניים רגיונליים של ארצות המזרח הקרוב. 4 חוברות תופענה בשנה.

העתון נועד בעיקר להחזקת הקשרים ולחלופי ידיעות עם העולם הבוטני שמחוץ לארץ.
לכל מאמר ינתן סכום קצר בעברית.

בזה הננו מודים לגב. ורה שלומונס על סיועה החשוב בהוצאת סדרת ירושלים של העתון הזה.

עתון לבוטניקה

מופיע בשתי סדרות

א. סדרת ירושלים:

יוצאת לאור ע"י חבר העובדים של המחלקה לבוטניקה באוניברסיטה העברית ירושלים (המנהל: ד"ר א. איג). בכל שנה מופיעות 4 חוברות וכל חוברת נושאת עליה את תאריך הופעתה. כל כרך שנתי מכיל מ"ע 300 עד 400 עמודים.

ב. סדרת רחבות:

יוצאת לאור ע"י ה. ר. אופנהימר וי. ריכרט של התחנה לחקר החקלאות, רחבות, א"י. בכל שנה מופיעות 2 חוברות וכל חוברת נושאת עליה את תאריך הופעתה. כל כרך שנתי מכיל מ"ע 200 עד 250 עמודים.

*

את דמי החתימה יש לשלם למפרע ע"י שק או המחאת דואר לפי הכתובת: ההנהלה של העתון לבוטניקה, ת. ד. 620, ירושלים. מחיר החתימה הוא:

1,250 לא"י לשנה, בעד שתי הסדרות

0,900 לא"י לשנה בעד סדרת ירושלים בלבד

0,600 לא"י לשנה בעד סדרת רחבות בלבד

בסכום זה נכללים גם דמי המשלוח.

(מחיר חוברת בודדת 0,300 לא"י רשל כפולה 0,600 לא"י)

*

במכתבים הנוגעים לענייני המערכת של סדרת ירושלים יש לפנות ל"עתון לבוטניקה", ת. ד. 620, ירושלים — ולענייני המערכת של סדרת רחבות ל"עתון לבוטניקה", ת. ד. 15, רחבות.

*

במכתבים עסקיים, בכלל זה הודעה על שגוי כתובת, מודעות וכו' יש לפנות להנהלת העתון לבוטניקה ת. ד. 620, ירושלים.

(המשך התכן של חוברת א')

ח השפעת המשרה של גרגירי חטה על הנביטה והגדול. מאת ג. מושיוב . . .

העכוב בנביטה וביצירת השרשים הנגרם על ידי הטפול בנפרת-נחושת ובטולו של

ט עכוב זה. מאת ג. מושיוב

ט מתווה ההתפתחות של החלדון על *Anchusa strigosa* Labill. מאת חיה חבלסקה . . .

ט הנביטה של דבקון חוית *Viscum cruciatum* Sieb. מאת י. גלימצ'ר

יא הגן הבוטני על שם יוסף מונטגיו למפורט. מאת א. איג

יא "גן שלומית". מאת א. איג

יב לזכרו של גרשון מושיוב 1913—1936

ע ת ו ז ל ב ו ט נ י ק ה

סדרת ירושלים

יוצא לאור על ידי
חבר העובדים של המחלקה לבוטניקה באוניברסיטה העברית
(המנהל: א. איג)

ת כ ן

עמוד

מקדש לזכרו של פרופ' אוטו ורבורג

א	מהמערכת
ב	אוטו ורבורג 1859 — 1938
ד	על החלוקה הפיטוגיאוגרפית של ארץ ישראל. מאת א. איג
ד	השמוש בחמרי צמיחה להשרשת צמחים והשבחתם I. מאת מ. אבן-ארי וא. קוניס
ה	אצות של המעינות החמים בצרת השחר (קלירוחי). מאת פ. פרמי וט. רייס
ה	להכרת ההתרבות הבגטיבית אצל הגיאופיטים של המזרח הקרוב. מאת מ. זהרי
ו	מחקר מונוגרפי של הסוג <i>Bellevalia</i> (קרילוגיה, טכסונומיה, גיאוגרפיה). מאת נעמי פינברון
ז	חקירות בעדשי ארץ-ישראל II. נגי העדשה התרבותית <i>Lens esculenta</i> Moench בארץ-ישראל. מאת ד. ו. זיצ'ק
ז	מבחן קריטי של המינים האורינוטליים של הסוג <i>Picris</i> (ובכללם גם <i>Hagioseris</i>) של עשבת האוניברסיטה העברית. מאת א. איג
ח	<i>Stigmatella</i> — סוג חדש ממשפחת <i>Cruciferae</i> מאת א. איג
ח	<i>Mosheovia</i> — סוג חדש ממשפחת <i>Scrophulariaceae</i> מאת א. איג (המשך מעבר לדף)